ANNOTATED COPY

INSTRUCTION MANUAL

FOR

WJ-8718 HF RECEIVER

WATKINS-JOHNSON

CHATHAM RADIO/WCC
BOX 397
N. CHATHAM, MASS. 02650

INSTRUCTION MANUAL

FOR

WJ-8718 HF RECEIVER

This document and subject matter disclosed herein are proprietary items to which Watkins-Johnson Company retains the exclusive right of dissemination, reproduction, manufacture and sale.

This document is provided to the individual or using organization for their use alone in the direct support of the associated equipment unless permission for further disclosure is expressly granted in writing.

WATKINS-JOHNSON COMPANY
700 QUINCE ORCHARD ROAD
GAITHERSBURG, MARYLAND 20760

Revision V
01/80: 500

WARNING

This equipment employs dangerous voltage which may be fatal if contacted. Exercise extreme caution in working with this equipment with any of the protective covers removed.

CAUTION

Leakage of the Nickel-Cadmium battery (A6A1BT1) supplied with Type 791575 Manual Tuning Up/Down Counter (A6A1) has been reported, and the probable causes are being investigated. If the battery is installed, it should be removed to prevent possible damage to the equipment from corrosion.

January 29, 1980

ERRATA

The following corrections to the WJ-8718 Instruction Manual (Revision V, 01/80) should be noted and incorporated in the text.

1) Page 2-4, Paragraph 2.3.11, 3rd line; change "Figure 6-18" to "Figure 6-19".

2) Page 3-3a, Paragraph 3.2.2a, 2nd line; change "Figure 6-3a" to "Figure 6-1a".

3) Page 3-40, Paragraph 3.3.7.3, 2nd line; change "Figure 6-14" to "Figure 6-15".

4) Page 3-47, Paragraph 3.4.2, 5th line; change "Figure 6-20" to "Figure 6-23".

5) Page 3-51, Paragraph 3.4.9, 4th line; change "Figure 6-20" to "Figure 6-21".

6) Page 3-51, Paragraph 3.4.10, 2nd line; change "Figure 6-20" to "Figure 6-21".

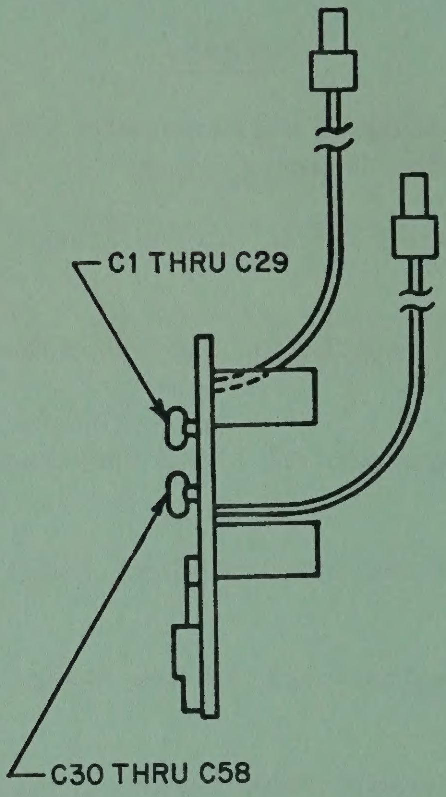
7) Page 4-56, Paragraph 4.7.16.2, item 1; change "Figure 6-13" to "Figure 6-23".

8) Section V, Replacement Parts List, page 5-52, Paragraph 5.5.5, TYPE 791570 SYNTHESIZER MOTHERBOARD; add listing for U1 and U2, Integrated Circuits, Part no. 7805 UC, Mfr. Code 07263.

9) Section V, Replacement Parts List, page 5-53, Figure 5-52, Type 791570 Synthesizer Motherboard (A5);

    a) Add capacitor C61 between L3 and L1.

    b) The labeling on the side view detail should be changed as shown on the following page.


C1 THRU C29
C30 THRU C58

January 18, 1980
ADDENDUM I

This addendum provides maintenance and repair information for type 791616 RF Filter assemblies containing a 30 MHz Low Pass Input Filter PC board, part no. 280093. Type 791616 RF Filter is a subassembly (A2) of the WJ-8718 HF Receiver. Included in this addendum is testing and troubleshooting information which replaces paragraph 4.7.4 in the WJ-8718 Instruction Manual, as well as a new RF Filter alignment procedure.

RF FILTER TESTING AND TROUBLESHOOTING

RF Filter Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and an RF Voltmeter (refer to Table 4-2 in the WJ-8718 Manual) are required to perform the procedures given below.

A. RF FILTER CHECKOUT PROCEDURE

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph B below for fault isolation information.

1. Disconnect A2P1 from A3A1J1 on the Input Converter (A3).

2. Connect the Signal Generator RF output to A2J1 on the receiver rear panel. Set the Signal Generator output frequency to 1.0 MHz and output level to 0 dBm.

3. Connect the RF Voltmeter and 50 Ω adapter to A2P1. Set the RF voltmeter to the 0 dBm range.

4. The RF Voltmeter should indicate between 0 and -2 dBm.

5. Manually sweep the Signal Generator output frequency from 1 MHz to 30 MHz, maintaining output level at 0 dBm. The filter output level should not be less than -2 dBm between 1 MHz and 30 MHz.

6. Disconnect the test equipment from the receiver.

7. Reconnect A2P1 to A3A1J1.

B. RF FILTER FAULT ISOLATION

The following list of supplementary troubleshooting data is used as an aid in fault isolation. Use the troubleshooting data to trace the fault to a defective component or connection. After the fault has been corrected, check the RF Filter for normal operation by repeating the checkout procedure given in paragraph A above.

1.	Figure 6-1a.	RF Filter Schematic Diagram
2.	Paragraph 3.2.2a.	RF Filter Circuit Description
3.	Figure 5-6a.	RF Filter Location of Components
4.	Paragraph 4.7.23.	Parts Replacement Guidelines
5.	Addendum I	RF Filter Alignment procedure

RF FILTER ALIGNMENT

The following alignment procedure is intended to be used only if necessary, not on a periodic basis.

1. Deenergize the receiver.

2. Connect the test equipment to the receiver as shown in Figure 1.

3. Set up the Sweep Generator as follows:

a.	Power	- ON
b.	CW/Sweep	- SYM
c.	Trig/Line/Free	- Line
d.	Fast/Slow/Manual	- Fast
e.	Crystal Cal.	- Off
f.	Range	- 110
g.	Sym Sweep Width Vernier	- 10 MHz
h.	1 kHz Mod.	- Off
i.	Output Level	- 10 dBm
j.	Frequency	- 20 MHz.

4. Set the Marker Generator for a 30 MHz output, unmodulated, at -10 dBm.

5. Adjust L1, L2, L3, L4, and L5 for minimum insertion loss and minimum ripple out to 30 MHz. Insertion loss should typically be less than 2 dB.

6. Disconnect the test equipment from the receiver.

7. This completes the RF Filter Alignment procedure.

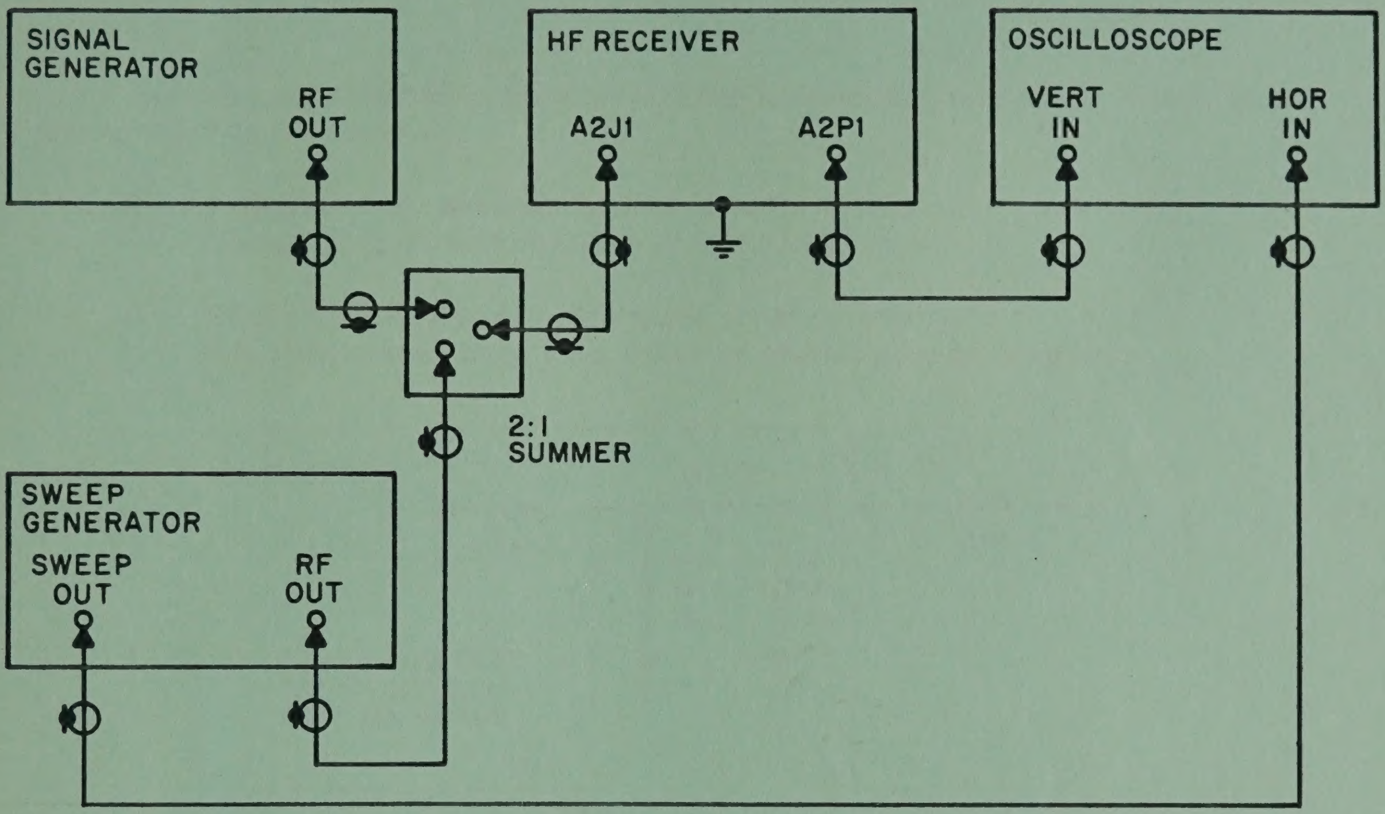


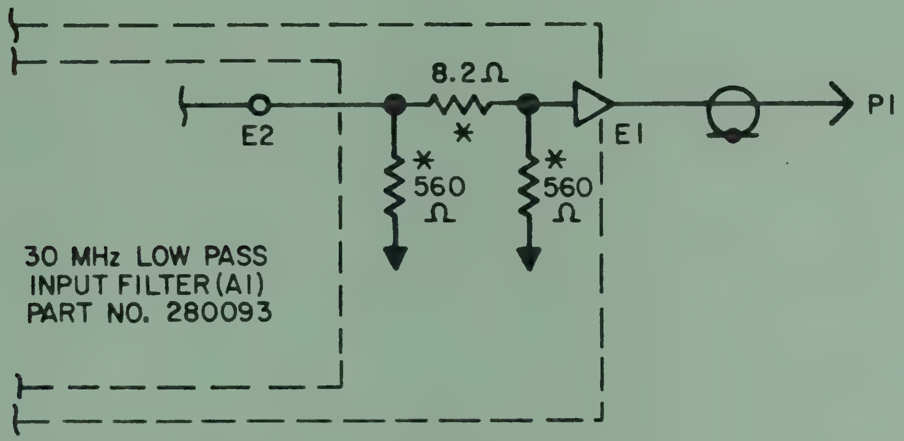
Figure 1. Test Setup, RF Input Filter Alignment.

January 25, 1980
ADDENDUM II

The following component changes should be incorporated in the instruction manual for the WJ-8718 HF Receiver.

1. Paragraph 5.5, Receiver Main Chasis Parts List:
   Change T1 from Part 34518 to Part 380083.

2. 791616 Input Filter (A2), Schematic Diagram 380082:
   Add components to the Input Filter as shown in the drawing below



* Denotes added components

3. 791596 USB Filter Switch (A4A4), Schematic Diagram 480102:
   Change C6 from 270 pF to 0.1 μF (34475-1, Vendor 14632)
   Change L1 from 470 μH to 1.0 mH (2500-18, Vendor 99800)
   Change R23 from 2k Ω to 500 Ω (62PR500, Vendor 73138)
   Change R24 from 220 Ω to 100 Ω (RCR07G101J8, Vendor 81349)

4. 791597 ISB/LSB Filter Switch (A4A5), Schematic Diagram 480105:
   Change C6 from 270 pF to 0.1 μF (34475-1, Vendor 14632)
   Change L1 from 470 μH to 1.0 mH (2500-18, Vendor 99800)
   Change R32 from 2k Ω to 500 Ω (62PR500, Vendor 73138)
   Change R5 from 220 Ω to 100 Ω (RCR07G101JS, Vendor 81349)

5. 791599 FM/CW/SSB Detector (A4A9), Schematic Diagram 43198:
   Change C16 from 0.47 μF to 1.0 μF (8131-050-651-105m, Vendor 72982)

6. 7459 Audio Amplifier (A4A10), Schematic Diagram 43230:
   Change C7 from 0.47 μF to 1.0 μF (813-050-651-105M, Vendor 72982)
   Change C8 from 0.1 μF to 0.47 μF (34452-1, Vendor 14632)

Change R6 from 2.0k Ω to 20k Ω (RCR07G203JS, Vendor 81349)
Delete 1%, 0.1W at R9 and R10.

7. 791600 1st and 3rd Lo Synthesizer (A5A1A2), Schematic Diagram 61247:
Change Q6 and Q7 from 2N2222A to 2N706 (Vendor 80131)
Delete C40.

8. 791601 2nd Lo Synthesizer (A5A2), Schematic Diagram 61256
Change C59 from 22pF to 33pF (308-000C0G0-330J, Vendor 72982)
Change C66 from 5.6pF to 2.7pF (301-000C0J0-279C, Vendor 72982)
Change C67 from 6.8pF to 5.6pF (301-00U2J0-569D, Vendor 72982)

9. 791575 Manual Tuning Up/Down Counter (A6A1), Schematic Diagram 51180:
Change R4 from 1k Ω to 10k Ω (RCR07G103JS, Vendor 81349)

10. 791598 ISB Detector/Audio (A4A8), Schematic Diagram 43231:
Change R58 and R59 from 270 Ω to 150 Ω (RCR07G151JS, Vendor 81349)

January 28, 1980
ADDENDUM III

This addendum contains precautionary information concerning possible leakage of nickel-cadmium battery A6A1BT1 in the WJ-8718 HF Receiver. Battery A6A1BT1 is used for memory retention of the tuned frequency in the event of power interruption. At present, the cause of leakage has not been identified. Potential causes range from defective batteries to discharge during receiver storage. It is recommended that users of the WJ-8718 HF Receiver remove type 791575 Manual Tuning Up/Down Counter (A6A1) from the receiver and inspect battery A6A1BT1 and surrounding surfaces for evidence of leakage and/or corrosion. Some cases of corrosion have been reported to be severe enough to cause the Manual Tuning Up/Down Counter to malfunction.

If evidence of corrosion is discovered, remove battery A6A1BT1 from the Manual Tuning Up/Down Counter and clean the A6A1 printed circuit assembly as described in the Recommended Procedure given below. If no evidence of corrosion is discovered, battery A6A1BT1 may be left intact on the Manual Tuning Up/Down Counter. It is recommended that periodic inspection of battery A6A1BT1 and surrounding surfaces be made to preclude any damage to receiver components as a result of leakage and/or corrosion.

RECOMMENDED PROCEDURE

1. Using Figure 1, locate and remove battery A6A1BT1 (part no. K02A11SP1) by cutting leads. Remove battery A6A1BT1 (model no. DS25D) by removing solder from battery-to-assembly connections on the rear of Manual Tuning Up/Down Counter A6A1 board.

2. Inspect Battery A6A1BT1 and surrounding surfaces for evidence of leakage and/or corrosion. If evidence is discovered, rinse the A6A1 printed circuit assembly with lukewarm water and mild soap solution to remove any battery electrolyte and corrosion.

3. Dry the A6A1 printed circuit assembly thoroughly in an oven for approximately 10 to 15 minutes at 50° C (122° F). A heat gun may also be used; however, care must be exercised so that components are not damaged by excessive heat.

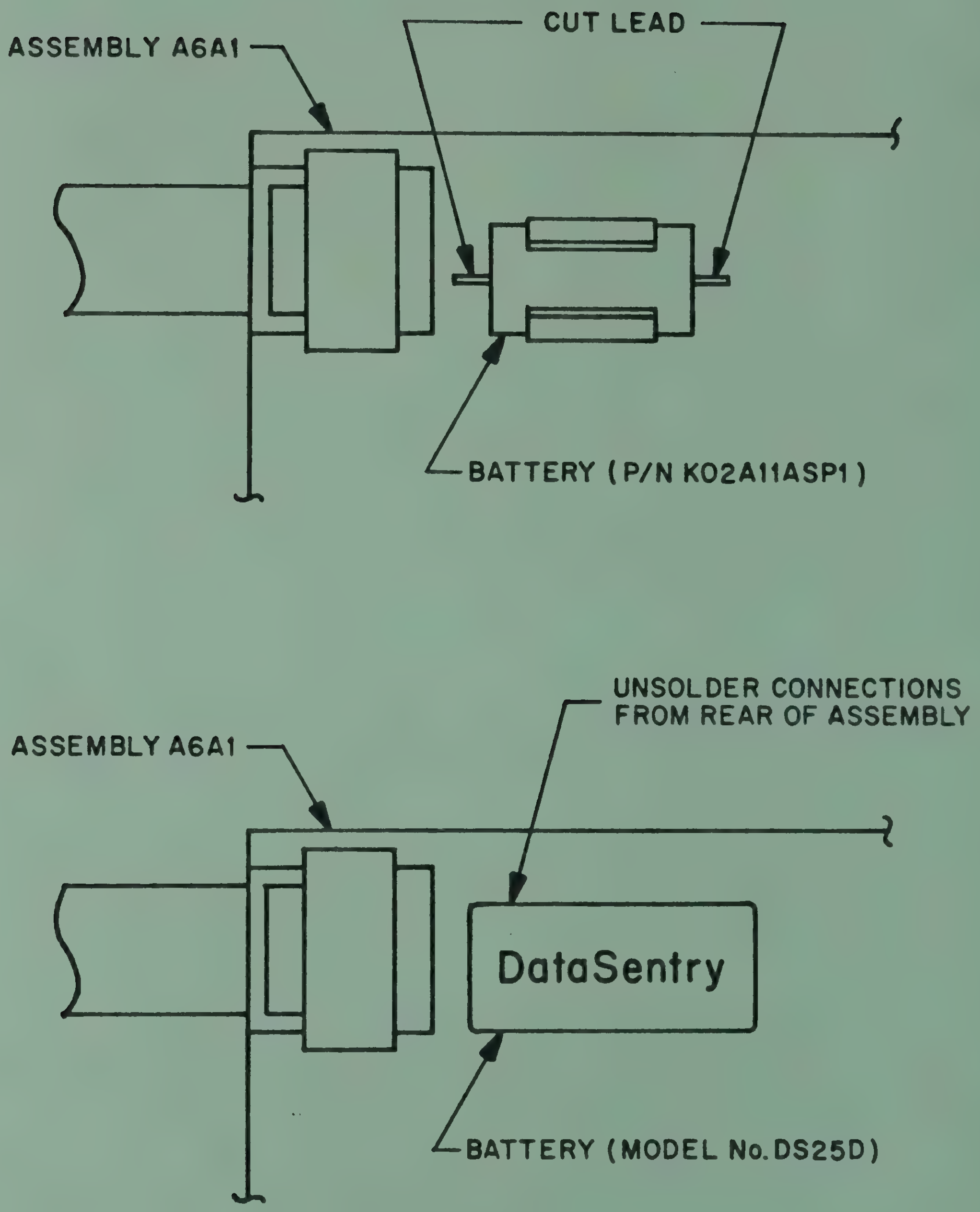


Figure 1. Battery A6A1BT1 Removal

January 28, 1980
ADDENDUM IV

This addendum provides maintenance information for type 791601 2nd LO Synthesizer, designated as subassembly A5A2 of the WJ-8718 HF Receiver. Reported incidents of frequency shift in some WJ-8718 units have been attributed to loss of lock in the 2nd LO phase lock loop (PLL) which contains adjustable capacitor A5A2 C61. Aging of one or more components in the 2nd LO circuitry is believed to cause a decrease in the dynamic range of the PLL tuning voltage which, in turn, results in loss of lock. This problem is most likely to occur in WJ-8718 units on a maximum yearly maintenance cycle, or in WJ-8718 units that are not periodically realigned during normal preventive maintenance. The alignment procedure and performance test given below should be conducted if the previously described problem is encountered.

ALIGNMENT PROCEDURE

Follow the general requirements for test and alignment procedures as outlined in the WJ-8718 Instruction Manual and proceed as follows:

1. Energize the receiver and tune to 15.00499 MHz.
2. Connect a DVM to test point E1, or module pin B57 on type 791570 Synthesizer Motherboard (A5), and adjust C51 for a 3.0 Vdc reading.
3. Connect a DVM to test point E3, or module pin A51 on type 791570 Synthesizer Motherboard (A5), and adjust L8 for a 4.0 Vdc reading.
4. Connect a DVM to test point E2, or module pin A55 on type 791570 Synthesizer Motherboard (A5), and adjust C61 for a 3.0 Vdc reading.
5. Connect a DVM to test point E1 and ensure that C51 is adjusted for a 3.0 Vdc reading.

PERFORMANCE TEST

1. Connect a frequency counter to the 2nd LO output that connects to A2J1 of type 791592 Input Converter (A3).
2. Tune the receiver to 15.00000 MHz and verify a reading of 32.21000 MHz.*
3. Tune the receiver to 15.00500 MHz and verify a reading of 32.20500 MHz.*
4. Tune the receiver to 15.00999 MHz and verify a reading of 32.20001 MHz.*

* This frequency will be shifted by thirty-two (32) times any 1 MHz time base error (counter or receiver time base); e.g., if the 1 MHz output is read as 1.000001, then the reading in performance test step 2 will be 32.21000 MHz+32 Hz or 32.21003 MHz.

January 29, 1980
ADDENDUM V

I.C. FAILURE

This addendum provides precautionary information concerning reported failure of certain integrated circuit (IC) components used on type 791600 1st and 3rd LO Synthesizer, a subassembly (A5A1A2) of the WJ-8718 HF Receiver.

In early 1978, an abnormally high failure rate was reported for four (4) N8292A IC's used in the 1st and 3rd LO Synthesizer. To date, the cause of failure has not been identified. The four N8292A IC's designated as U15, U17, U18, and U19, have since been replaced by SN74LS196N IC's in the manufacture of the 1st and 3rd LO Synthesizer. Part no. N8292A is manufactured by Signetics Corporation and part no. SN74LS196N is manufactured by Texas Instruments Inc.

The increased power consumption of SN74LS196N IC's over that of N8292A IC's necessitated a change of value for R64 from 10 Ω to 3.3 Ω and the addition of heat sink RA1 to regulator VR1 on the 1st and 3rd LO Synthesizer. N8292A IC's which have functioned properly for more than six (6) months in WJ-8718 HF Receivers should continue to do so, therefore, no wholesale replacement of the N8292A IC's is necessary. N8292A IC's used on the 1st and 3rd LO Synthesizer should only be replaced, after referring to the Replacement Information given below, if an actual failure occurs.

REPLACEMENT INFORMATION

If two (2) or more N8292A IC's must be replaced with SN74LS196N IC's on the 1st and 3rd LO Synthesizer, it is also necessary to change the value of R64 from 10 Ω to 3.3 Ω and to install heat sink RA1 on regulator VR1. The recommended heat sink for use is part no. 2251B, manufactured by the Thermalloy Company. Refer to Figure 5-26 in the WJ-8718 Instruction Manual for location of parts on type 791600 1st and 3rd LO Synthesizer.

February 5, 1980
ADDENDUM VI

FIELD BULLETIN

GENERAL:

A problem has become apparent in the battery backup circuit of the WJ-8718 Type 791575 A6A1 logic card. Due to the nature of the nickel-cadmium battery used, there exists a possibility for the battery to become fully discharged, reverse polarity, and leak, causing harm to the printed circuit board. Prior to shipping or an extended period of shelf storage it is necessary to remove the battery from the printed circuit card and store it separately from the radio. Also, during normal use of the equipment it is necessary to check the condition of the battery and to perform preventive maintenance steps to insure the reliability of the unit and safety of the printed circuit components.

TESTING BEFORE INSTALLING A NEW BATTERY:

Sealed cell batteries are normally shipped in a discharged condition. Prior to installation nickel-cadmium sealed cells may be checked as follows:

Measure the open circuit voltage. If the measurement is equal to or greater than one volt, the cell is acceptable. If the voltage is less than one volt, the cell may be defective or inadvertently shorted down during shipping or handling. To determine if the cell is defective, follow the procedures below:

1. Apply a charge voltage of 5V through 240 Ω for 30 seconds.

2. Discharge through the same load for same time.

3. Measure open circuit voltage, if less than one volt cell is defective. If above one volt, cell is acceptable.

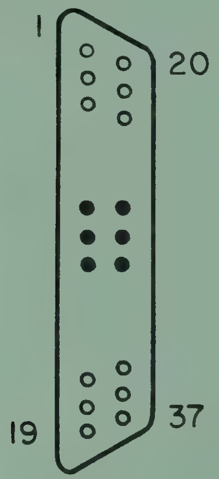
PREVENTIVE MAINTENANCE:

No maintenance of the battery itself is required, but it is recommended that the battery voltage be monitored for its ability to hold a charge. Also, the A6A1 printed circuit card should be periodically inspected for signs of battery deterioration such as a build up of residue on battery terminals or a sign of battery leakage in and around the seals. If any of these conditions exist, the battery should be discarded.

February 26, 1980
ADDENDUM VII

This Addendum clarifies the pin number locations for A6A1J1 Multipin Connector used on Type 791575-2 Manual Tuning UP/DOWN Counter as part of MCM-2 Option in WJ-8718 and WJ-8716 HF Receivers.

"D" CONNECTOR
(Mfg. Part No. 609-37S)



WATKINS-JOHNSON
(MCM-2)

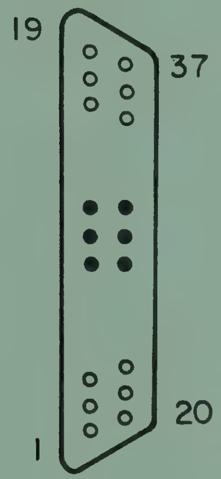


TABLE OF CONTENTS

SECTION I

GENERAL DESCRIPTION

Paragraph Page

1.1 Electrical Characteristics 1-1
1.2 Mechancial Characteristics 1-2
1.3 Equipment Supplied 1-2
1.4 Equipment Required But Not Supplied. 1-3
1.5 Optional Equipment 1-3

SECTION II

INSTALLATION AND OPERATION

2.1 Unpacking and Inspection 2-1
2.2 Preparation For Reshipment and Storage 2-1
2.3 Installation 2-1
2.3.1 Voltage Selector/Fuse Block and Line Card Receptacle (F1J1) 2-3
2.3.2 RF Input (A2J1) 2-3
2.3.3 Alternate Fuseholder (XF2) 2-3
2.3.4 IF Output (J12) 2-3
2.3.5 Terminal Board (TB1). 2-3
2.3.6 Terminal Board (TB2). 2-4
2.3.7 Line Audio Level (R1) 2-4
2.3.8 Clock Switch (S2) 2-4
2.3.9 1 MHz Ref (J11) 2-4
2.3.10 Phones Jack (J13) 2-4
2.3.11 Remote Input Option (A6A1J1). 2-4
2.4 Operation. 2-6
2.4.1 Push On/Off Power (S1). 2-6
2.4.2 Meter (M1) 2-6
2.4.3 Meter Switches 2-6
2.4.4 Gain Mode 2-6
2.4.5 RF Gain Control 2-7
2.4.6 Detection Mode 2-7
2.4.7 IF Bandwidth (kHz). 2-8
2.4.8 BFO Offset 2-8
2.4.9 Tuned Frequency Readout 2-8
2.4.10 Manual Tuning Module (A7) 2-8
2.4.11 Phone Level Control 2-9
3.1 General. 3-1
3.1.1 Overall Description 3-1
3.2 Receiver Section. 3-1

TABLE OF CONTENTS (Cont'd)

SECTION III

CIRCUIT DESCRIPTION

Paragraph		Page
3.2.1	Functional Description	3-1
3.2.2	Type 791616 RF Filter (A2)	3-3
3.2.2a	Type 791616 RF Input Filter (A2)	3-3a
3.2.3	Type 791592 Input Converter (A3)	3-3
3.2.4	Type 791569 IF Motherboard (A4)	3-4
3.2.5	Type 791594 10.7 MHz Filter Switch (A4A1)	3-4
3.2.5a	Type 791594 10.7 MHz Filter Switch (A4A1) (Revision E)	3-4a
3.2.6	Type 71430 10.7 MHz/455 kHz Converter (A4A2)	3-5
3.2.7	Type 791595 455 kHz Filter Switch (A4A3)	3-5
3.2.8	Type 791596 USB Filter Switch Option (A4A4)	3-6
3.2.8a	Type 791596 USB Filter Switch Option (A4A4) (Revision G)	3-6a
3.2.9	Type 791597 ISB/LSB Filter Switch Option (A4A5)	3-6
3.2.9a	Type 791597 ISB/LSB Filter Switch Option (A4A5) (Revision E)	3-6a
3.2.10	Type 72488 455 kHz Amplifier/AM Detector (A4A7)	3-7
3.2.11	Type 78112 AGC (A4A6)	3-7
3.2.12	Type 791599 FM/CW/SSB Detector (A4A9)	3-10
3.2.13	Type 7459 Audio Amplifier (A4A10)	3-11
3.2.14	Type 791598 ISB Detector/Audio Option (A4A8)	3-12
3.3	Synthesizer Section	3-15
3.3.1	Synthesizer Relationships	3-15
3.3.2	Phase Lock Loops	3-16
3.3.2.1	General	3-16
3.3.2.2	Basic Phase Lock Loop	3-18
3.3.2.3	Phase Lock Loop Prescaling Technique	3-19
3.3.2.4	Phase Detector	3-20
3.3.3	Type 791600 Time Base Circuits (A5A1A2)	3-22
3.3.3.1	Functional Description	3-22
3.3.3.2	Circuit Description	3-22
3.3.4	Type 791600 3rd LO Synthesizer (A5A1A2)	3-24
3.3.4.1	Functional Description	3-24
3.3.4.2	Circuit Description	3-25
3.3.5	Type 791576 BFO Synthesizer (A5A3)	3-25
3.3.5.1	Functional Description	3-25
3.3.5.2	Circuit Description	3-25
3.3.6	Type 791601 2nd LO Synthesizer (A5A2)	3-28
3.3.6.1	Functional Description	3-28
3.3.6.2	Circuit Description	3-29
3.3.7	Type 791600 1st LO Synthesizer (A5A1A2)	3-31
3.3.7.1	Functional Description	3-31
3.3.7.2	Circuit Description	3-33
3.3.7.2.1	Counting Cycle	3-33
3.3.7.2.2	Prescaler, U1 and U2A	3-34

TABLE OF CONTENTS (Cont'd)

SECTION III (Concluded)

CIRCUIT DESCRIPTION (Concluded)

Paragraph Page

3.3.7.2.3 Digital Code Converter U4 3-35
3.3.7.2.4 Programmable Counter U9, U10, U11 3-36
3.3.7.2.5 Swallow Counter U8 and U9 3-36
3.3.7.2.6 Carry Condition U12A and U6B 3-36
3.3.7.2.7 Count Sequence 3-36
3.3.7.2.8 Divider Section Terminal Count 3-39
3.3.7.3 VCO Band Select Code 3-40
3.3.8 Type 791629 Voltage Controlled Oscillator (A5A1A1) 3-40
3.3.8.1 Functional Description 3-40
3.3.8.2 Circuit Description. 3-41
3.3.9 Type 791630 lst and 3rd LO Synthesizer/Time Base (A5A1). 3-42
3.4 Digital Control Section 3-42
3.4.1 Type 791575-2 Manual Tuning Up/Down Counter (A6A1). 3-42
3.4.1.1 Integrated Circuit Data 3-42
3.4.1.2 Circuit Description. 3-45
3.4.2 Type 791828 Front Panel Interconnect (A6A2) 3-46
3.4.3 Type 791874-1 Manual Tuning Module (A7). 3-48
3.4.4 Type 791589 Tuning Resolution (A7A1) 3-48
3.4.5 Encoder Assembly (A7U1) 3-49
3.4.6 Type 791578 Frequency Display (A8) 3-50
3.4.7 Type 791588 BFO Switch (A9) 3-50
3.4.8 Type 791684 Front Panel Control (A10) 3-51
3.4.9 Type 791583 Upper Panel Control (A10A1). 3-51
3.4.10 Type 791826 Lower Panel Control (A10A2) 3-51
3.5 Power Supply Section 3-51
3.5.1 Type 76240 Power Distribution (A1) 3-52
3.5.2 Power Supply Regulators 3-52

SECTION IV

MAINTENANCE

4.1 General. 4-1
4.2 Cleaning and Lubrication 4-1
4.2.1 Cleaning 4-1
4.2.2 Lubrication 4-2
4.3 Inspection for Damage or Wear 4-3
4.4 Test Equipment Required 4-3
4.5 Corrective Maintenance Information 4-3
4.5.1 General. 4-3

TABLE OF CONTENTS (Cont'd)

SECTION IV (Cont'd)

MAINTENANCE (Cont'd)

Paragraph		Page
4.5.2	Procedure Guidelines	4-5
4.6	Performance Tests	4-5
4.6.1	General	4-5
4.6.2	Minimum Performance Standards	4-5
4.6.3	Procedure Guidelines	4-6
4.6.4	Operator Performance Test	4-13
4.6.5	IF Gain and Bandwidth Performance Test	4-13
4.6.6	S/N Ratio Performance Test	4-15
4.6.7	Detection Mode Performance Test	4-16
4.6.8	MAN/AGC Performance Test	4-19
4.6.9	Frequency Tuning Performance Test	4-20
4.7	Component Level Troubleshooting Procedures	4-33
4.7.1	General	4-33
4.7.2	Procedure Guidelines	4-33
4.7.3	Power Supply Testing and Troubleshooting	4-33
4.7.3.1	Power Supply Checkout Procedure	4-33
4.7.3.2	Power Supply Fault Isolation	4-34
4.7.4	RF Filter Testing and Troubleshooting	4-34
4.7.4.1	RF Filter Checkout Procedure	4-34
4.7.4.2	RF Filter Fault Isolation	4-35
4.7.5	Input Converter Testing and Troubleshooting	4-35
4.7.5.1	Input Converter Checkout Procedure	4-35
4.7.5.2	Input Converter Fault Isolation	4-36
4.7.6	10.7 MHz Filter Switch Testing and Troubleshooting	4-37
4.7.6.1	10.7 MHz Filter Switch Checkout Procedure	4-37
4.7.6.2	10.7 MHz Filter Switch Fault Isolation	4-38
4.7.6.2a	10.7 MHz Filter Switch Fault Isolation (Revision E)	4-38a
4.7.7	10.7 MHz/455 kHz Converter Testing and Troubleshooting	4-38
4.7.7.1	10.7 MHz/455 kHz Converter Checkout Procedure	4-39
4.7.7.2	10.7 MHz/455 kHz Converter Fault Isolation	4-39
4.7.8	455 kHz Filter Switch Testing and Troubleshooting	4-40
4.7.8.1	455 kHz Filter Switch Checkout Procedure	4-40
4.7.8.2	455 kHz Filter Switch Fault Isolation	4-40
4.7.9	USB Filter Switch Testing and Troubleshooting	4-41
4.7.9.1	USB Filter Switch Checkout Procedure	4-42
4.7.9.2	USB Filter Switch Fault Isolation	4-42
4.7.9.2a	USB Filter Switch Fault Isolation (Revision G)	4-42a
4.7.10	ISB/LSB Filter Switch Testing and Troubleshooting	4-43
4.7.10.1	ISB/LSB Filter Switch Checkout Procedure	4-43
4.7.10.2	ISB/LSB Filter Switch Fault Isolation	4-44
4.7.10.2a	ISB/LSB Filter Switch Fault Isolation (Revision E)	4-44a
4.7.11	455 kHz Amplifier/AM Detector Testing and Troubleshooting	4-44

TABLE OF CONTENTS (Cont'd)

SECTION IV (Cont'd)

MAINTENANCE (Cont'd)

Paragraph Page

4.7.11.1 455 kHz Amplifier/AM Detector Checkout Procedure 4-45
4.7.11.2 455 kHz Amplifier/AM Detector Fault Isolation 4-45
4.7.12 FM/CW/SSB Detector Testing and Troubleshooting 4-46
4.7.12.1 CW/SSB Detector Checkout Procedure 4-46
4.7.12.2 FM Detector Checkout Procedure 4-47
4.7.12.3 FM/CW/SSB Detector Fault Isolation 4-47
4.7.13 Audio Amplifier Testing and Troubleshooting 4-49
4.7.13.1 Audio Amplifier Checkout Procedure 4-49
4.7.13.2 Audio Amplifier Fault Isolation 4-49
4.7.14 ISB Detector/Audio Testing and Troubleshooting 4-50
4.7.14.1 ISB Detector/Audio Checkout Procedure 4-50
4.7.14.2 ISB Detector/Audio Fault Isolation 4-51
4.7.15 AGC Testing and Troubleshooting 4-52
4.7.15.1 AGC Checkout Procedure 4-52
4.7.15.2 AGC Fault Isolation 4-53
4.7.16 Front Panel Interconnect Testing and Troubleshooting. 4-55
4.7.16.1 Front Panel Interconnect Checkout Procedure 4-55
4.7.16.2 Front Panel Interconnect Fault Isolation 4-56
4.7.17 Lower Panel Control Testing and Troubleshooting 4-56
4.7.17.1 Lower Panel Control Checkout Procedure 4-56
4.7.17.2 Lower Panel Control Fault Isolation 4-57
4.7.18 1st LO Synthesizer Testing and Troubleshooting 4-57
4.7.18.1 1st LO Synthesizer Checkout Procedure. 4-57
4.7.18.2 1st LO Synthesizer Fault Isolation 4-58
4.7.18.3 1st LO Synthesizer Supplementary Troubleshooting Data 4-60
4.7.19 2nd LO Synthesizer Testing and Troubleshooting 4-60
4.7.19.1 2nd LO Synthesizer Checkout Procedure 4-60
4.7.19.2 2nd LO Synthesizer Fault Isolation 4-60
4.7.19.3 2nd LO Synthesizer Supplementary Troubleshooting Data 4-63
4.7.20 3rd LO Synthesizer Testing and Troubleshooting 4-63
4.7.20.1 3rd LO Synthesizer Checkout Procedure. 4-64
4.7.20.2 3rd LO Synthesizer Fault Isolation 4-64
4.7.20.3 3rd LO Synthesizer Supplementary Troubleshooting Data 4-64
4.7.21 BFO Synthesizer Testing and Troubleshooting 4-65
4.7.21.1 BFO Synthesizer Checkout Procedure. 4-65
4.7.21.2 BFO Synthesizer Fault Isolation 4-65
4.7.21.3 BFO Synthesizer Supplementary Troubleshooting Data 4-67
4.7.22 Time Base Testing and Troubleshooting 4-67
4.7.22.1 Time Base Checkout Procedure 4-67
4.7.22.2 Time Base Fault Isolation 4-68
4.7.22.3 Time Base Supplementary Troubleshooting Data 4-68
4.7.23 Parts Replacement Guidelines 4-68

TABLE OF CONTENTS (Cont'd)

SECTION IV (Concluded)

MAINTENANCE (Concluded)

Paragraph		Page
4.7.23.1	Soldering Techniques	4-69
4.7.23.2	Component Replacement	4-69
4.7.23.3	Realignment	4-69
4.8	Adjustment/Alignment Procedures	4-69
4.8.1	General	4-69
4.8.2	Synthesizer Alignment	4-70
4.8.2.1	1st LO Synthesizer Alignment	4-70
4.8.2.2	2nd LO Synthesizer Alignment (A5A2)	4-70
4.8.2.3	2nd LO Filter Adjustment	4-73
4.8.2.4	3rd LO Synthesizer Alignment	4-73
4.8.2.5	2 MHz Time Base Adjustment	4-74
4.8.2.6	BFO Synthesizer Alignment	4-74
4.8.3	Receiver Alignment	4-74
4.8.3.1	Input Converter Alignment	4-74
4.8.3.2	10.7 MHz Filter Switch Adjustment	4-76
4.8.3.2a	10.7 MHz Filter Switch Adjustment (Revision E)	4-76a
4.8.3.3	455 kHz Amplifier/AM Detector Response Alignment	4-77
4.8.3.4	455 kHz Amplifier/AM Detector Gain Adjustment	4-79
4.8.3.5	USB Filter Switch and ISB/LSB Filter Switch Adjustment	4-79
4.8.3.5a	USB Filter Switch and ISB/LSB Filter Adjustment	4-80a
4.8.3.6	ISB Detector/Audio Adjustment	4-80
4.8.3.7	FM Discriminator Alignment	4-82
4.8.4	LED Intensity Adjustment	4-84

SECTION V

REPLACEMENT PARTS LIST

5.1	Unit Numbering Method	5-1
5.2	Reference Designation Prefix	5-1
5.3	List of Manufacturers	5-1
5.4	Parts List	5-4
5.5	Type WJ-8718 HF Receiver, Main Chassis	5-6
5.5.1	Type 76240 Power Distribution (A1)	5-13
5.5.2	Type 791616 RF Filter (A2)	5-15
5.5.2A	Part 280093 30 MHz Low Pass Filter (A2A1)	5-15C
5.5.3	Type 791592-1 Input Converter (A3)	5-16
5.5.3.1	Part 34748 1st Mixer, 1st IF (A3A1)	5-17
5.5.3.2	Part 34749 2nd Mixer/2nd IF Amplifier (A3A2)	5-19
5.5.3.3	Part 280080 Filter Board (A3A3)	5-21

TABLE OF CONTENTS (Concluded)

SECTION V (Concluded)

REPLACEMENT PARTS LIST (Concluded)

Paragraph Page

5.5.4 Type 791569 IF Motherboard (A4) 5-22
5.5.4.1 Type 791594 10.7 MHz Filter Switch (A4A1) 5-25
5.5.4.1A Type 791594 10.7 MHz Filter Switch (A4A1) 5-27A
5.5.4.2 Type 71430 10.7 MHz/455 kHz Converter (A4A2) 5-29
5.5.4.3 Type 791595 455 kHz Filter Switch (A4A3). 5-31
5.5.4.4 Type 791596 USB Filter Switch (A4A4) (Option) 5-33
5.5.4.4A Type 791596 USB Filter Switch (A4A4). 5-33A
5.5.4.5 Type 791597 ISB/LSB Filter Switch (A4A5) (Option) 5-35
5.5.4.5A Type 791597 ISB/LSB Filter Switch (A4A5) 5-36A
5.5.4.6 Type 78112 AGC Amplifier (A4A6) 5-37
5.5.4.7 Type 72488 455 kHz Amplifier/AM Detector (A4A7). 5-39
5.5.4.8 Type 791598 ISB Detector/Audio (A4A8) 5-43
5.5.4.9 Type 791599 FM, CW, and SSB Detector (A4A9) 5-47
5.5.4.10 Type 7459 Audio Amplifier (A4A10) 5-49
5.5.5 Type 791570 Synthesizer Motherboard (A5) 5-52
5.5.5.1 Type 791630 1st and 3rd LO Synthesizer/Time Base (A5A1). 5-55
5.5.5.1.1 Type 791629 1st LO VCO Assembly (A5A1A1) 5-57
5.5.5.1.1.1 Part 34750 1st LO Voltage Controlled Oscillator (A5A1A1A1) 5-58
5.5.5.1.2 Type 791600 1st and 3rd LO Synthesizer (A5A1A2) 5-61
5.5.5.2 Type 791601 2nd LO Synthesizer (A5A2) 5-67
5.5.5.3 Type 791576 BFO Synthesizer (A5A3) 5-73
5.5.6 Type 791580 I/O Motherboard (A6) 5-77
5.5.6.1 Type 791575-2 Manual Tuning Up/Down Counter (A6A1) 5-79
5.5.6.2 Type 791828 Front Panel Interconnect (A6A2). 5-80
5.5.7 Type 791874-1 Manual Tuning Module (A7) 5-81
5.5.7.1 Type 791589 Tuning Resolution (A7A1). 5-83
5.5.8 Type 791578 Frequency Display (A8). 5-85
5.5.9 Type 791827 BFO Switch (A9). 5-86
5.5.10 Type 791684-2 Front Panel Control (A10). 5-87
5.5.10.1 Type 791583 Upper Panel Control (A10A1) 5-88
5.5.10.2 Type 791826 Lower Panel Control (A10A2) 5-89

SECTION VI

SCHEMATIC DIAGRAMS

LIST OF ILLUSTRATIONS

Figure		Page
1-1	WJ-8718 HF Receiver	1-0
2-1	WJ-8718 Receiver, Critical Dimensions	2-0
2-2	WJ-8718 HF Receiver, Front Panel View	2-2
2-3	WJ-8718 HF Receiver, Rear Panel View	2-2
3-1	WJ-8718 Overall Block Diagram	3-0a
3-2	Receiver Section, Functional Block Diagram	3-0b
3-3	Simplified AGC Circuit	3-9
3-4	Frequency Synthesizers Functional Relationships	3-14
3-5	Basic Phase Lock Loop Configuration	3-17
3-6	Programmable Phase Lock Loop	3-18
3-7	Two-Modulus Prescaling in the Phase Lock Loop	3-19
3-8	Prescaler Dividing Technique	3-20
3-9	Phase Detector Timing Diagram	3-21
3-10	Time Base Circuits Functional Block Diagram	3-23
3-11	Tri-State Buffers	3-23
3-12	3rd LO Functional Block Diagram	3-24
3-13	BFO Functional Block Diagram	3-26
3-14	2nd LO Functional Block Diagram	3-28
3-15	2nd LO Prescaler Timing Diagram	3-30
3-16	1st LO Functional Block Diagram	3-32
3-17	1st LO Counting Cycle	3-34
3-18	1st LO Prescaler Timing Diagram	3-35
3-19	Two-Pulse Early Decode, Count Termination	3-39
3-20	VCO Functional Block Diagram	3-41
3-21	Digital Section Functional Block Diagram	3-43
3-22	Manual Tuning Up/Down Counter Block Diagram	3-44
3-23	Up/Down Counter Integrated Circuit Data	3-44
3-24	Front Panel Interconnect Integrated Circuit Data	3-47
3-25	Encoder Assembly Timing Diagram	3-49
4-1a	Corrective Maintenance Flowchart	4-8
4-1b	Corrective Maintenance Flowchart	4-10
4-1c	Corrective Maintenance Flowchart	4-12
4-2	IF Gain and Bandwidth Performance, Test Setup	4-15
4-3	S/N Ratio Performance, Test Setup	4-16
4-4	Detection Mode Performance, Test Setup	4-18
4-5	MAN/AGC Performance, Test Setup	4-20
4-6	Frequency Tuning Performance, Test Setup	4-21
4-7	Power Supply Troubleshooting Tree	4-24
4-8	Input Converter Troubleshooting Tree	4-24
4-9	10.7 MHz Filter Switch Troubleshooting Tree	4-24
4-10	455 kHz Filter Switch Troubleshooting Tree	4-26
4-11	USB Filter Switch Troubleshooting Tree	4-26
4-12	ISB/LSB Filter Switch Troubleshooting Tree	4-26
4-13	455 kHz Amplifier/AM Detector Troubleshooting Tree	4-28
4-14	FM/CW/SSB Detector Troubleshooting Tree	4-28
4-15	FM Detector Troubleshooting Tree	4-28
4-16a	Audio Amplifier Troubleshooting Tree	4-30
4-16b	Audio Amplifier Troubleshooting Tree	4-30

LIST OF ILLUSTRATIONS (Cont'd)

Figure		Page
4-17a	ISB Detector/Audio Troubleshooting Tree	4-32
4-17b	ISB Detector/Audio Troubleshooting Tree	4-32
4-18	Phase Detector Timing Diagram	4-59
4-19	Input Converter Alignment, Test Setup	4-75
4-20	10.7 MHz Filter Switch Adjustment, Test Setup	4-76
4-20a	10.7 MHz Filter Switch Adjustment, Test Setup	4-76a
4-21	455 kHz Amplifier/AM Detector Response Alignment, Test Setup	4-78
4-22	455 kHz Amplifier/AM Detector Response Alignment, Typical Response	4-78
4-23	455 kHz Amplifier/AM Detector Gain Adjustment, Test Setup	4-79
4-24	ISB Detector/Audio Adjustment, Test Setup	4-81
4-25	FM Discriminator Alignment, Test Setup	4-83
4-26	FM Discriminator Alignment, Typical Response	4-83
5-1	WJ-8718 HF Receiver, Front Panel, Location of Components	5-7
5-2	WJ-8718 HF Receiver, Rear View, Location of Components	5-7
5-3	WJ-8718 HF Receiver, Top View, Location of Components	5-9
5-4	WJ-8718 HF Receiver, Bottom View, Location of Components	5-11
5-5	Type 76240 Power Distribution (A1), Location of Components	5-14
5-6	Type 791616 RF Filter (A2), Location of Components	5-15A
5-6A	Type 791616 Input Filter (Product Improvement) A2, Location of Components	5-15B
5-6B	Part 280093 30 MHz Low Pass Filter (Product Improvement) A2A1, Location of Components	5-15C
5-7	Type 791592-1 Input Converter (A3)	5-16
5-8	Part 34748 1st Mixer, 1st IF (A3A1)	5-17
5-9	Part 34749 2nd Mixer/2nd IF Amplifier (A3A2)	5-18
5-10	Part 280080 Filter Board (A3A3), Location of Components	5-21
5-11	Type 791569 IF Motherboard (A4), Location of Components	5-23
5-12	Type 791594 10.7 MHz Filter Switch (A4A1), Location of Components	5-26
5-12A	Type 791594 10.7 MHz Filter Switch, (Product Improvement) A4A1, Location of Components	5-27C
5-13	Type 71430 10.7 MHz/455 kHz Converter (A4A2), Location of Components	5-28
5-14	Type 791595 455 kHz Filter Switch (A4A3), Location of Components	5-30
5-15	Type 791596 USB Filter Switch (A4A4), Location of Components	5-32
5-15A	Type 791596 USB Filter Switch (Product Improvement) A4A4, Location of Components	5-33B
5-16	Type 791597 ISB, LSB Filter Switch (A4A5)	5-34
5-16A	Type 791597 ISB/LSB Filter Switch (Product Improvement) Location of Components	5-36
5-17	Type 78112 AGC Amplifier (A4A6), Location of Components	5-36B
5-18	Type 72488 455 kHz Amplifier/AM Detector (A4A7), Location of Components	5-40
5-19	Type 791598 ISB Detector/Audio (A4A8), Location of Components	5-42
5-20	Type 791599 FM, CW, and SSB Detector (A4A9), Location of Components	5-46
5-21	Type 7459 Audio Amplifier (A4A10), Location of Components	5-50

LIST OF ILLUSTRATIONS (Cont'd)

Figure Page

5-22 Type 791570 Synthesizer Motherboard (A5), Location of Components 5-53
5-23 Type 791630 1st and 3rd LO Synthesizer/Timebase (A5A1), Location of Components 5-56
5-24 Type 791629 1st LO VCO Assembly (A5A1A1), Location of Components . . . 5-57
5-25 Part 34750 1st LO Voltage Controlled Oscillator (A5A1A1A1), Location of Components 5-60
5-26 Type 791600 1st and 3rd LO Synthesizer (A5A1A2), Location of Components 5-62
5-27 Type 791601 2nd LO Synthesizer (A5A2), Location of Components 5-66
5-28 Type 791576 BFO Synthesizer (A5A3), Location of Components. 5-72
5-29 Type 791580 I/O Motherboard (A6), Location of Components 5-76
5-30 Type 791575-2 Manual Tuning Up/Down Counter (A6A1), Location of Components 5-78
5-31 Type 791828 Front Panel Interconnect (A6A2), Location of Components 5-80
5-32 Type 791874-1 Manual Tuning Module (A7), Location of Components 5-81
5-33 Type 791874-1 Manual Tuning Module (A7), Rear View, Location of Components 5-82
5-34 Type 791589 Tuning Resolution (A7A1), Location of Components 5-83
5-35 Type 791578 Frequency Display (A8), Location of Components 5-84
5-36 Type 791827 BFO Switch (A9), Location of Components 5-86
5-37 Type 791684-2 Front Panel Control (A10), Location of Components 5-87
5-38 Type 791583 Upper Panel Control (A10A1), Location of Components 5-88
5-39 Type 791826 Lower Panel Control (A10A2), Location of Components 5-89
6-1 Type 791616 RF Filter (A2), Schematic Diagram 34437 6-1
6-1a Type 791616 Input Filter (A2), Schematic Diagram 380082 . . . . 6-1a
6-2 Type 791592 Input Converter (A3), Schematic Diagram 51178 . . . . 6-3a
6-3 Type 791594 10.7 MHz Filter Switch (A4A1), Schematic Diagram 51177 6-5
6-3a Type 791594 10.7 MHz Filter (A4A1), Schematic Diagram 480103 . . . . . 6-5a
6-4 Type 71430 10.7 MHz/455 kHz Converter (A4A2), Schematic Diagram 34384 6-7
6-5 Type 791595 455 kHz Filter Switch (A4A3), Schematic Diagram 43561 6-9
6-6 Type 791596 USB Filter Switch Option (A4A4), Schematic Diagram 43196 6-11
6-6a Type 791596 USB Filter Switch Option (A4A4), Schematic Diagram 480102 . . . . 6-11a
6-7 Type 791597 ISB/LSB Filter Switch Option (A4A5), Schematic Diagram 43249 6-13
6-7a Type 791597 ISB/LSB Filter Switch Option (A4A5), Schematic Diagram 480105 . . . . 6-13a
6-8 Type 78112 AGC (A4A6), Schematic Diagram 43229 6-15
6-9 Type 72488 455 kHz Amplifier/AM Detector (A4A7), Schematic Diagram 51168 6-17
6-10 Type 791598 ISB Detector/Audio (A4A8), Schematic Diagram 43231. 6-19
6-11 Type 791599 FM/CW/SSB Detector (A4A9), Schematic Diagram 43198. . . . 6-21

LIST OF ILLUSTRATIONS (Concluded)

Figure Page

6-12 Type 7459 Audio Amplifier (A4A10), Schematic Diagram 43230. 6-23
6-13 Type 791630 1st and 3rd LO Synthesizer/Time Base Assembly (A5A1), Schematic Diagram 6-25
6-14 Type 791629 Voltage Controlled Oscillator (A5A1A1), Schematic Diagram 51198 6-27
6-15 Type 791600 1st and 3rd LO Synthesizer/Time Base (A5A1A2), Schematic Diagram 61247 (Sheet 1 of 2). 6-29
6-16 Type 791600 1st and 3rd LO Synthesizer/Time Base (A5A1A2), Schematic Diagram 61247 (Sheet 2 of 2). 6-31
6-17 Type 791601 2nd LO Synthesizer (A5A2), Schematic Diagram 61256 6-33
6-18 Type 791576 BFO Synthesizer (A5A3), Schematic Diagram 51183 6-35
6-19 Type 791576-2 Manual Tuning Up/Down Counter (A6A1), Schematic Diagram 51180 6-37
6-20 Type 791578 Frequency Display (A8), Schematic Diagram 43242 6-39
6-21 Type WJ-8718 HF Receiver Main Chassis, Schematic Diagram 580032 (Sheet 1 of 6 and Sheet 5 of 6) 6-41
6-22 Type WJ-8718 HF Receiver Main Chassis, Schematic Diagram 580032 (Sheet 2 of 6 and Sheet 3 of 6) 6-43
6-23 Type WJ-8718 HF Receiver Main Chassis, Schematic Diagram 580032 (Sheet 4 of 6 and Sheet 6 of 6) 6-45

LIST OF TABLES

Table Page

1-1 Type WJ-8718 HF Receiver, Specifications 1-5
2-1 Remote Input Lines Identification 2-5
3-1 Receiver IF Bandwidth Relationships 3-2
3-2 Detection Mode Output Signal Relationships 3-3
3-3 1st and 2nd LO Tuning Increments 3-16
3-4 1st and 2nd LO Frequencies Versus Tuned Frequency 3-17
3-5 Receiver's Phase Lock Loop Characteristics 3-21
3-6 Code Converter U4, Truth Table 3-35
3-7 Count Sequence, 1st LO Swallow Counter 3-37
3-8 1st LO Divider Count-Down Cycles. 3-38
3-9 Band Select Coding. 3-40
3-10 Data Selector 14512, Digit Control Codes 3-46
3-11 BFO Switch Truth Tables 3-51
4-1 Periodic Maintenance Schedule 4-1
4-2 Test Equipment Required 4-4
4-3 Receiver Minimum Performance Standards 4-6
4-4 Input Converter Voltage Table 4-36
4-5 10.7 MHz Filter Switch Voltage Table. 4-38

LIST OF TABLES (Concluded)

Table		Page
4-5a	10.7 MHz Filter Switch Voltage Table	4-38a
4-6	10.7 MHz/455 kHz Converter Voltage Table	4-39
4-7	455 kHz Filter Switch Voltage Table	4-41
4-8	USB Filter Switch Voltage Table	4-43
4-8a	USB Filter Switch Voltage Table (Revision G)	4-43a
4-9	ISB/LSB Filter Switch Voltage Table	4-44
4-9a	ISB/LSB Filter Switch Voltage Table	4-44a
4-10	455 kHz Amplifier/AM Detector Voltage Table	4-46
4-11	FM/CW/SSB Detector Voltage Table	4-48
4-12	Audio Amplifier Voltage Table	4-50
4-13	ISB Detector/Audio Voltage Table	4-52
4-14	AGC Voltage Table	4-53
4-15	Front Panel Interconnect Voltage Table	4-56
4-16	VCO Band Select Code	4-58
4-17	1st LO Frequency Chart	4-59
4-18	2nd LO Frequency Chart	4-63
4-19	BFO Frequency Chart	4-66
4-20	Output Divider U10 Frequency Chart	4-67
4-21	Time Base Frequency Chart	4-68
4-22	VCO Alignment Parameters	4-70
4-23	Loop Test Point Voltages	4-72
4-24	2nd LO Synthesizer Tuning Parameters	4-73

THIS PAGE LEFT BLANK

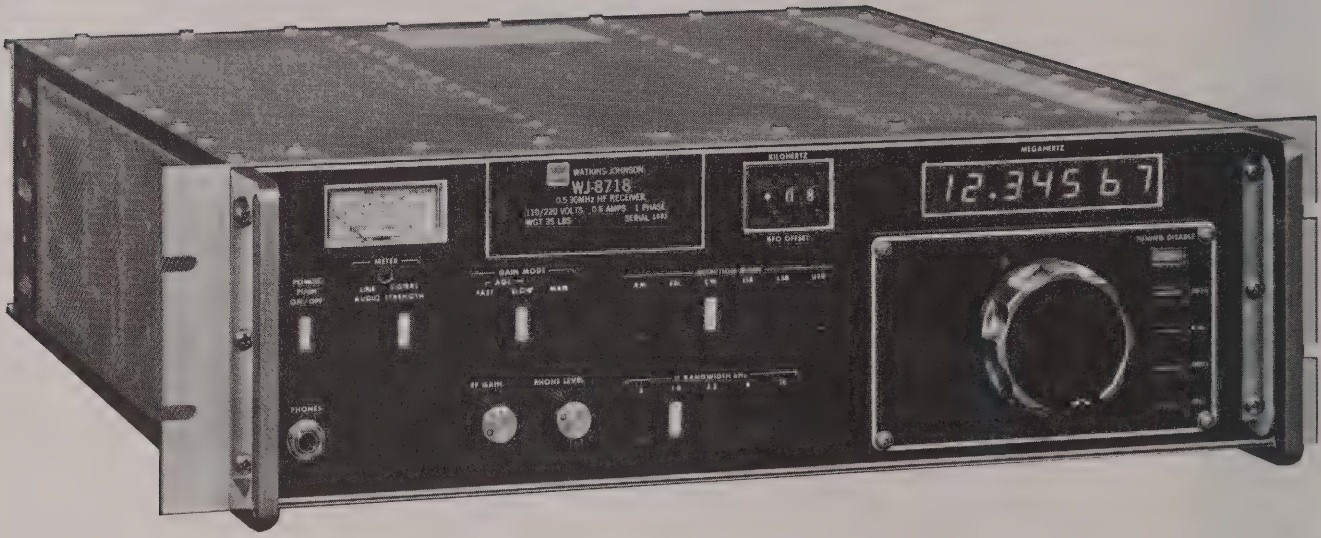


Figure 1-1. WJ-8718 HF Receiver

SECTION I
GENERAL DESCRIPTION

1.1 ELECTRICAL CHARACTERISTICS

The WJ-8718 HF Receiver is designed to receive AM, FM, CW, USB, LSB, and ISB emissions over the frequency range of 5 kHz to 29.99999 MHz. Manual control of the receiver is provided by selection of either MCM or MCM-2 options. In the manual mode, operating parameters are selected by pressing appropriate pushbutton/indicators. The depressed button indicates the selection of the operator by the appearance of a brightly colored display behind the clear front surface. Seven digits composed of light emitting diodes (LED's) indicate the tuned frequency to a resolution of 10 Hz. The large tuning knob and four tuning rate pushbuttons provide frequency tuning capability. A tuning disable pushbutton locks the receiver to a specific frequency, thereby preventing accidental operator frequency changes. The optional remote control mode is enabled by one of two methods: depressing the TUNING DISABLE pushbutton, or a control change activated by the remote device. A jumper wire on the Manual Tuning Up/Down Counter card determines the method employed. In the remote mode, the receiver will respond to parallel input data, consisting of frequency and bandwidth information, and is compatible with buffered CMOS levels.

Pushbutton-selectable parameters in addition to the operating modes are IF Bandwidths, Gain Mode, and Meter Select. Selectable IF bandwidths of 0.3 kHz, 1.0 kHz, 3.2 kHz, 6 kHz, and 16 kHz operate in conjunction with the AM, FM, or CW detection modes. When the optional ISB, LSB, or USB detection modes are chosen, IF bandwidth selection is ineffective due to the automatic override by the detection mode control. RF gain may be controlled manually or by Fast or Slow AGC. A dual-purpose meter indicates Signal Strength or Line Audio level.

Internal frequency tuning circuitry of the basic receiver includes the 1st, 2nd, and 3rd LO Synthesizers, and a BFO Synthesizer. The phase lock loop frequency synthesizers determine tuned frequency to a resolution of 10 Hz. The synthesized BFO tunes ±8.9 kHz from 455 kHz in 100 Hz and 1 kHz steps. A non-volatile memory stores the tuned frequency for a minimum of 48 hours after power interruption (i.e., power failure or manually turning power off).

Rear panel features include BNC connectors for a 50 Ω RF input, a 455 kHz IF output, and a 1 MHz reference input/output selectable by a related slide switch. Two five-lug terminal boards provide audio outputs that include: a 600 Ω floating center-tapped ISB output (for the lower sideband), a single-ended phone output, a center-tapped line audio output, and an FM/CW/SSB detector output for monitoring. Line voltage selection for high and low voltage conditions may be accomplished in a few seconds by inserting the printed circuit (PC) wafer in one of four positions in the line cord assembly.

Maintenance operations are straightforward due to the clean mechanical packaging and the placement of nearly all components on plug-in circuit boards. These circuit boards mount on motherboards having all pins accessible from the bottom of the receiver. Adjustments and alignments have been kept to a minimum. Removing the top cover exposes the assemblies, all of which may be unplugged from their sockets or freed from the main chassis by quick disconnect plugs. The dc power supplies are thermal and short circuit protected, require no adjustments, and can easily be replaced. A printed circuit wafer, accessible on the rear panel, makes possible the matching of the power transformer to line voltages of 110 Vac (±15%) and 220 Vac (±15%).

1.2 MECHANICAL CHARACTERISTICS

The receiver mounts in a standard 19-inch equipment rack, occupies 5.25 inches of vertical space, and extends 19.6 inches into the rack. The main chassis, front, rear, top, bottom, and internal compartment panels are constructed of aluminum. Side panels are cast aluminum, the front panel is a 0.19-inch thick aluminum plate, and the rear panel, main deck, and internal partitions are stamped aluminum. The side panels and top and bottom covers are perforated to allow for flow-through ventilation. All operating controls and indicators are on the front panel, while all input and output cables are connected to the rear panel (except for the phone jack). This package meets the radiation specification of MIL-STD-461A.

The front panel is overlaid with a black bezel etched with control markings. All of the pushbuttons are mounted on a printed circuit card positioned behind the front panel, and extend through cutouts in the front panel. All of the remaining controls and line audio/signal strength meter are mounted directly on the front panel. The tuned frequency numeric display is mounted on a card positioned behind a cutout in the front panel, over which a polarized filter is installed. The audio phones jack, RF gain control, and phone level control are also mounted on the front panel.

The rear panel mounts all input, output, and accessories, with the exception of the above mentioned phones jack. BNC connectors are supplied for the RF input, IF output, and 1 MHz reference input/output. The INT/EXT clock switch for selecting internal or external timebase reference is located next to the 1 MHz reference input/output. Two terminal blocks supply an output for Line Audio, Phone Audio, ISB Audio, and FM Audio. Two fuseholders are found on the rear panel. The circular fuseholder is used to hold the alternate line voltage fuse, while the rectangular fuseholder has the additional functions of line filter, voltage selection, and ac line cord receptacle. Also on the rear panel are +15 V, -15 V, and +5 V heat sinked regulators, a Line Audio potentiometer, and optional 37-pin female connectors for remote control.

Loosening 34 quarter-turn fasteners allows the top cover to be lifted from the receiver thus exposing four main compartments. A power distribution circuit, input converter, and optional preselector mount in one compartment and three synthesizer boards mount in another. The IF modules and the digital control circuits are also in separate compartments for mechanical support and shielding purposes.

Removing the bottom cover, also held in place by 34 quarter-turn fasteners, exposes three motherboards that mount a total of 27 modules and the components mounted on the front panel. All connections to the motherboards are made with push-on plugs so that replacement of a motherboard consists of removing less than 10 screws and the plugs.

1.3 EQUIPMENT SUPPLIED

The equipment supplied consists of the receiver and a detachable line cord.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED

Select equipment from the following general classifications to obtain full use of the receiver.

1. Antenna, 50 Ω
2. Audio monitoring equipment such as the following: (for monitoring ISB signals, two units will be required except for headphones, which monitors both sidebands.)
    - a) Speaker panel, 600 Ω
    - b) Stereo headphones, 600 Ω
    - c) Tape recorder
3. Wideband tape recorder for 455 kHz IF amplifier predetection output.
4. IF-to-tape converter for 455 kHz-to-video signal conversion.
5. Remote Input Interface - for receivers utilizing remote control operation. Refer to the Installation Section of this manual for definitions of the input lines.
6. Two extender cards are required (available from Watkins-Johnson) for troubleshooting to the component level.

1.5 OPTIONAL EQUIPMENT

The following optional equipment is available for use with the WJ-8718 HF Receiver. For additional information concerning these options and others, contact Watkins-Johnson Company, Gaithersburg, Maryland, or your Watkins-Johnson representative.

1.	Manual Control Module	WJ-8718/MCM*
2.	Remote/Manual Control Module	WJ-8718/MCM-2*
3.	Independent Sideband (ISB)	WJ-8718/ISB**
4.	Sub-Octave Preselector	WJ-8718/PRE
5.	IEEE-488 Bus Interface (Listen Only)	WJ-8718/488-1
6.	IEEE-488 Bus Interface (Talk/Listen)	WJ-8718/488-2
7.	10 Hz BFO Synthesizer	WJ-8718/B10
8.	Signal Monitor Output	WJ-8718/SMO
9.	Indicating Front Panel	WJ-8718/IFP
10.	Red LED Frequency Display	WJ-8718/RED

11.	Green LED Frequency Display	WJ-8718/GRN
12.	Microprocessor Front Panel	WJ-8718/MFP
13.	RS-232 Interface (Talk/Listen)	WJ-8718/232
14.	1 Hz Tuning	WJ-8718/1 Hz
15.	Carrier Operated Relay	WJ-8718/COR

* Note: Either MCM or MCM-2 is required with main frame for receiver operation.

** Note: Independent Sideband (ISB) option provides selectable ISB, LSB, and USB functions.

Table 1-1. Type WJ-8718 HF Receiver, Specifications

Tuning Range	5 kHz to 29.99999 MHz.
Tuning Resolution	10 Hz.
Antenna Conducted Oscillator Radiation	-87 dBm, maximum.
Antenna Input Protection	The antenna input will withstand the effects of RF power to +15 dBm and static build-up.
Input Impedance	50 Ω, unbalanced, nominal.
IF Bandwidths (3 dB)	Standard: 0.3, 1, 3.2, 6, and 16 kHz.
IF Shape Factor	IF BW — 60 dB: 3 dB, Typical 0.3 kHz — 7.0:1 1 kHz — 4.5:1 3.2 kHz — 2.5:1 6 kHz — 2.3:1 16 kHz — 2.0:1
Detection Modes	Standard: AM, FM, CW. Optional: LSB, USB, ISB.
Gain Control Modes	Manual, Fast AGC, Slow AGC.
AGC and Manual Range	100 dB, minimum.
AGC Threshold	3.0 μV, typical.
AGC Attack Time	15 ms, maximum.
AGC Release Time	Fast AGC: 25 ms, maximum. Slow AGC: 4 sec, maximum.
Frequency Display	7 digit, LED's.
Frequency Resolution/Readout	10 Hz.
Frequency Stability	6×10^{-8} per day, 2×10^{-6} per year.
Frequency Control	Manual or Remote options.
Synthesizer Lock-Up Time	3 ms, typical; 10 ms, maximum.
Synthesized BFO	455 kHz ±8.9 kHz in 100 Hz steps.
Power Interrupt	With the Manual Control Module option, storage of the frequency data will automatically occur. Upon restoration of power, the receiver will return to the previously tuned frequency.
IF Rejection	Greater than 90 dB.
Image Rejection	Greater than 90 dB.
Sensitivity (0.2-30 MHz, see CW Sensitivity for extended frequency range)	
AM Sensitivity (6 kHz IF Bandwidth)	A 1.7 μV signal 50% AM modulated at a 400 Hz rate will produce at least a 10 dB (S+N)/N ratio at the audio output.
FM Sensitivity (16 kHz IF Bandwidth)	A 2.5 μV signal FM modulated at a 400 Hz rate to a 4.8 kHz peak deviation will produce at least a 17 dB (S+N)/N ratio at the audio output.

Table 1-1. Type WJ-8718 HF Receiver, Specifications (Continued)

CW Sensitivity (0.3 kHz IF Bandwidth)	
200 kHz-30 MHz	A 0.4 μV signal will produce a 16 dB (S+N)/N ratio at the audio output.
50 kHz-200 kHz	A 0.63 μV signal will produce a 16 dB (S+N)/N ratio at the audio output.
15 kHz-50 kHz	A 1.4 μV signal will produce a 16 dB (S+N)/N ratio at the audio output.
5 kHz-15 kHz	A 63 μV signal will produce a 16 dB (S+N)/N ratio, typically at the audio output.
ISB, (USB, LSB) Sensitivity (3 kHz SSB Bandwidth)	A 0.56 μV signal will produce a 10 dB (S+N)/N ratio at the audio output.
Audio Outputs:	
ISB Output	100 mW, maximum across 600 Ω.
Line Audio	2 W, minimum, across 600 Ω for an input signal of 3 μV, 30% AM modulated at a 400 Hz ratio.
Headphone Output*	30 mW, minimum, for an input signal of 3 μV, 30% AM modulated at a 400 Hz rate.
Audio Distortion	Less than 5% at rated audio output.
Audio Frequency Response	±1.5 dB from 100 Hz to 8 kHz, 1 kHz reference frequency.
Final IF Output	20 mV, minimum, into 50 Ω for input signals greater than 3.0 μV.
Intermodulation Distortion:	
3rd Order Input Intercept Point	+20 dBm, minimum for signals separated by 30 kHz, (performance may degrade below 3 MHz).
Unwanted Sideband Rejection	50 dB at 350 Hz into unwanted sideband.
Signal Meter	Indicates carrier level or line audio level.
Reciprocal Mixing	With a desired signal of 25 μV in the 3.2 kHz IF bandwidth, the desired signal-to-noise ratio will be greater than 20 dB, when an undesired signal 70 dB higher in amplitude and 30 kHz removed in frequency is present.
Cross Modulation	With a desired signal of 10 μV an undesired signal 70 dB higher, 30% AM modulated will produce less than 10% cross modulation for frequency separation of greater than 50 kHz in the 1 kHz IF bandwidth.
Operating Temperature Range**	0°C to 50°C.
Power Consumption	0.6 A at 115 Vac, approximately.
Power Requirements	110/220 Vac ±15% 48-420 Hz.

Table 1-1. Type WJ-8718 HF Receiver, Specifications (Continued)

Size	5.25 inches high, 19 inches wide and 19.4 inches deep.
Weight	35 pounds (15.75 kilograms), approximately.

* Note: The stereo headphone output will provide 30 mW for each sideband in the ISB mode; USB output available on the stereo phone "tip", LSB output available on stereo phone "ring".

** Note: Operation within specifications guaranteed at $25^{\circ}C \pm 5^{\circ}C$.

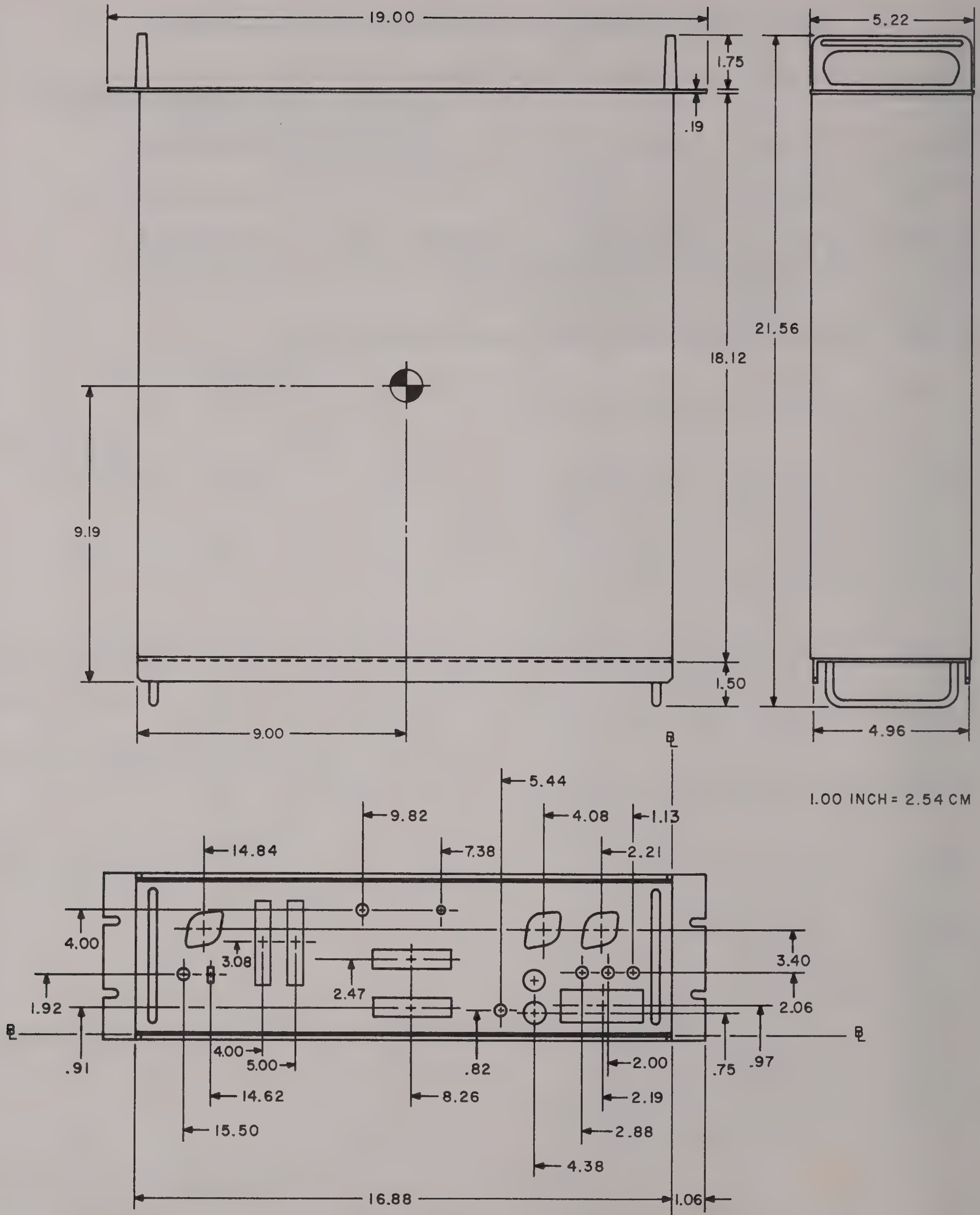


Figure 2-1. WJ-8718 Receiver, Critical Dimensions

SECTION II

INSTALLATION AND OPERATION

2.1 UNPACKING AND INSPECTION

Examine the shipping carton for damage before the WJ-8718 is unpacked. If the carton has been damaged, try to have the carrier's agent present when the equipment is unpacked. If not, retain the shipping cartons and padding material for the carrier's inspection if damage to the equipment is evident after it has been unpacked.

See that the equipment is complete as listed on the packing slip. Contact Watkins-Johnson Company, Gaithersburg, Maryland, or your Watkins-Johnson representative with details of any shortage.

The unit was thoroughly inspected and factory adjusted for optimum performance prior to shipment. It is, therefore, ready for use upon receipt. After uncrating and checking contents against the packing slip, visually inspect all exterior surfaces for dents and scratches. If external damage is visible, remove the dust covers and inspect the internal components for apparent damage. Then check the internal cables for loose connections, and plug-in items such as printed wiring boards, which may have been loosened from their receptacles.

2.2 PREPARATION FOR RESHIPMENT AND STORAGE

If the WJ-8718 must be prepared for reshipment, the packaging methods should follow the pattern established in the original shipment. If retained, the original materials can be reused to a large extent or will at a minimum provide guidance for the repackaging effort. Conditions during storage and shipment should normally be limited as follows:

Maximum humidity: 95% (no condensation)

Temperature range: -30°C to 85°C

2.3 INSTALLATION

The receiver is designed for mounting in a standard 19-inch equipment rack. It occupies 5.25 inches of vertical rack space and extends approximately 19.62 inches into the rack to the tips of the rear protective handles. Critical dimensions are shown in Figure 2-1. Do not rely solely on front panel mounting hardware to support the receiver. A brace extending along the sides from the front panel to the rear panel is preferred. The rack should allow a free flow of air through top and bottom covers and side panels, as well as around the outer surfaces of the receiver.

Access to the rear panel should be allowed so that input and output connections can be conveniently made or changed if desired. Figures 2-2 and 2-3 are photographs of the front and rear panels showing the locations of the connectors. Described below are the functions and input/output parameters of each connector.

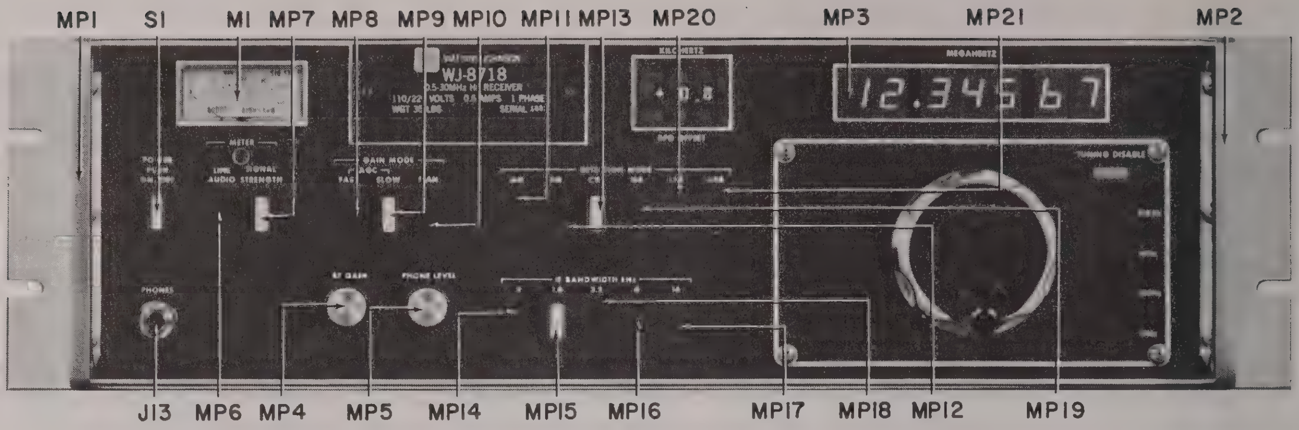


Figure 2-2. WJ-8718 HF Receiver, Front Panel View

* DENOTES HIDDEN PARTS

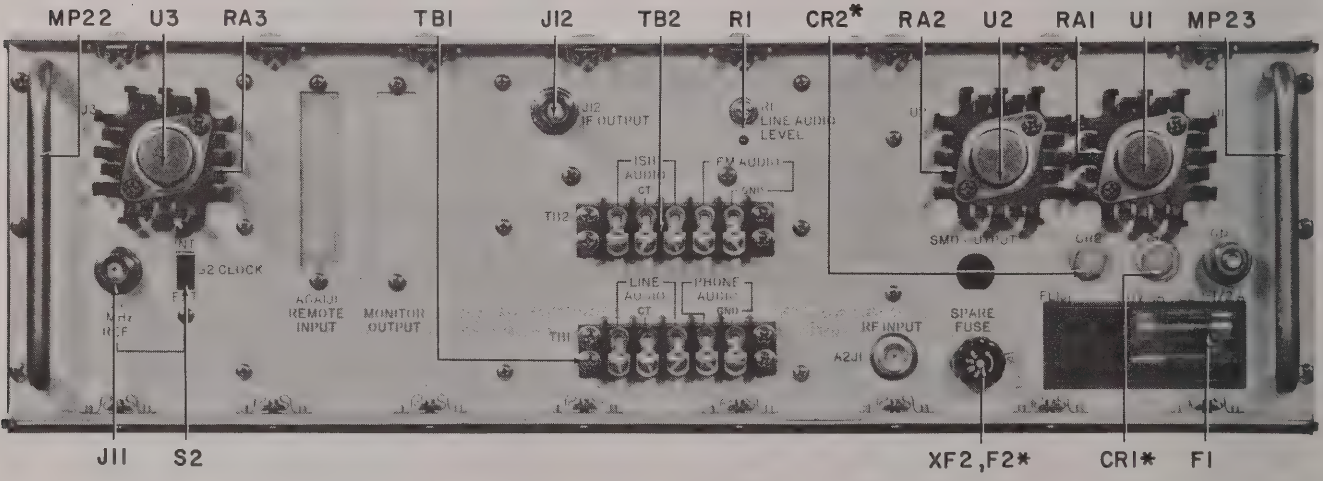


Figure 2-3. WJ-8718 HF Receiver, Rear Panel View

2.3.1 VOLTAGE SELECTOR/FUSE BLOCK AND LINE CORD RECEPTACLE (FL1J1)

This assembly should always be inspected before installation of the receiver in a new location. With the line cord unplugged, the clear plastic window can be slid over the three male power receptacle prongs. This exposes the line fuse and a hinged, plastic FUSE PULL lever.

Swinging of the FUSE PULL lever to the left ejects the fuse from the holder and frees a line-voltage-select PC wafer found at the bottom of the assembly. Looking down on the PC wafer at a slight angle on the left side shows the selected line voltage for the receiver, either 100, 120, 220, or 240 Vac. If the voltage shown does not match the available line voltage, remove the PC wafer and reinstall it so that the closest line voltage is visible with the PC wafer in position; the PC wafer should be set in the voltage position closest to the line voltage being used. Then install the fuse suitable for the line voltage: 1 A, slow-blow for 100 Vac and 120 Vac, or 1/2 A, slow-blow for 220 Vac and 240 Vac. Install the other fuse in the alternate fuseholder.

Slide the clear plastic window back over the fuse and PC wafer portion of the assembly holder and insert the line cord in the receptacle.

2.3.2 RF INPUT (A2J1)

This BNC connector is the RF signal input for the receiver. Nominal input impedance is 50 Ω. The input is protected against signals exceeding +15 dBm (1.25 V rms) and static build-up.

2.3.3 ALTERNATE FUSEHOLDER (XF2)

This fuseholder provides convenient storage of the fuse for the line voltage not in use. There is no electrical connection to the fuseholder.

2.3.4 IF OUTPUT (J12)

This BNC connector supplies a 455 kHz IF output. The level will be 20 mV, minimum, into 50 Ω in AGC mode, for RF input signals greater than 3 μV.

2.3.5 TERMINAL BOARD (TB1)

Two audio outputs are available on this board. They will be described separately.

1. LINE AUDIO. These three terminals provide a floating, 600 Ω, center tapped audio output. This output will drive a 600 Ω load from zero (0) W to at least 2 W (0 V to 34.6 V rms) depending on the setting of rear panel LINE AUDIO LEVEL potentiometer R1. This line voltage is monitored by the front panel meter when the LINE AUDIO METER switch is engaged.

2. PHONE AUDIO. This single ended output is in parallel with the front panel PHONES jack and is meant to drive a 600 Ω load. Output level is controlled by the front panel PHONE LEVEL potentiometer and will typically be a maximum of 7.8 V rms.

2.3.6 TERMINAL BOARD (TB2)

These outputs will be described separately.

1. ISB AUDIO. Three of the terminals on this board provide a floating, center tapped, balanced output for driving a 600 Ω load. When in the ISB mode, only the LSB signal is available from this output. No other signal is available from these terminals. Audio level may be set to a maximum of 100 mW (7.75 V rms) using a potentiometer on printed circuit card A4A8. The USB signal for the ISB mode appears at the LINE AUDIO terminals of TB1.

2. FM AUDIO. This is a dc-coupled monitor voltage from the discriminator. Measure with a high impedance voltmeter.

2.3.7 LINE AUDIO LEVEL (R1)

This potentiometer adjusts the level of audio signals appearing at the LINE AUDIO terminals of TB1. The front panel meter monitors this output when the related LINE AUDIO switch is engaged. Rotating this control fully clockwise will provide at least a 2 W audio output (34.6 V rms/+33 dBm) into 600 Ω.

2.3.8 CLOCK SWITCH (S2)

Setting this switch to the INT position selects the internal time base for the receiver and provides the internal 1 MHz reference output at J11. Setting this switch to the EXT position deactivates the internal reference so that an external signal may be applied to J11.

2.3.9 1 MHz REF (J11)

When the CLOCK switch is in the INT position, this BNC connector provides a 1 MHz, 100 mV rms output into 50 Ω. When the switch is set in the EXT position, a 1 MHz reference signal of at least 50 mV rms into 50 Ω must be applied to J11 to provide a time base for the receiver.

2.3.10 PHONES JACK (J13)

This output is intended to drive a 600 Ω, or greater, stereo headphone set. When operating in the (optional) ISB mode, both USB and LSB information can be monitored simultaneously through the headphones. Mono headphones, however, may be used with loss of LSB when operating in the ISB mode. In all other modes, both stereo and mono headphones will provide essentially the same results.

2.3.11 REMOTE INPUT OPTION (A6A1J1)

When this 37-pin input connector is provided, remote tuning is enabled by manually pressing the TUNING DISABLE pushbutton, or internally by connecting a jumper wire in Manual Tuning Up/Down Counter A6A1, as described in Note 4 of Figure 6-18. Frequency tuning and IF bandwidth can be remotely selected in AM, FM, or CW modes. Other modes automatically determine IF bandwidth. Identification of the Remote Input lines is shown in Table 2-1.

Table 2-1. Remote Input Lines Identification

Up/Down Counter Board A6A1		Remote Input A6A1J1	
E20		Pin- 9	3.2 kHz
E12		Pin- 5	0.3 kHz
E32		Pin-15	1.0 kHz
E24		Pin-11	6.0 kHz
E28		Pin-13	16 kHz
E16		Pin-33	BW enable
E39	2^0	Pin-37	10^1
E29		Pin-32	
E30		Pin-14	
E38	2^3	Pin-18	
E37	2^0	Pin-36	10^2
E34		Pin-16	
E33		Pin-34	
E35	2^3	Pin-35	
E26	2^0	Pin-12	10^3
E13		Pin-24	
E14		Pin- 6	
E25	2^3	Pin-30	
E22	2^0	Pin-10	10^4
E18		Pin- 8	
E17		Pin-26	
E21	2^3	Pin-28	
E10	2^0	Pin- 4	10^5
E08		Pin- 3	
E04		Pin- 1	
E09	2^3	Pin-22	
E06	2^0	Pin- 2	10^6
E11		Pin-23	
E15		Pin-25	
E5	2^3	Pin-20	
E36	2^0	Pin-17	10^7
E40	2^1	Pin-19	
E7		Pin-21	Load
E19		Pin-27	
E23		Pin-29	Ground lines
E27		Pin-31	

2.4 OPERATION

All front panel controls and indicators are described here. The pushbuttons have a mechanical interlock arrangement so that only one button of any group may be in at a time. Partial depression of a button in the out position releases any button previously depressed. A depressed button will be indicated by a brightly colored display behind the clear front surface. If no button has been depressed in any functional grouping, that particular mode will be inactive. For an explanation of front panel features, refer to the following paragraphs.

2.4.1 PUSH ON/OFF POWER (S1)

Press this button in to energize the receiver. During initial installation, be sure the line-voltage-select PC wafer on the rear panel matches the available line voltage before energizing the receiver. Refer to paragraph 2.3.1 for the voltage selection procedure.

2.4.2 METER (M1)

The meter contains two scales of which one is a signal strength scale with a range of 0 to 110 dB. This signal strength scale contains a MAN SET mark on the scale to indicate proper signal strength in the MAN gain mode. The other scale on the meter indicates the audio level of the LINE AUDIO output in dB above 1 mW, referenced to 600 Ω.

2.4.3 METER SWITCHES

The two switches, LINE AUDIO and SIGNAL STRENGTH, determine what function the meter will indicate. Both of these functions are explained below.

1. LINE AUDIO. With this switch engaged, the rear panel LINE AUDIO terminals can be set for 0 to 2 W output (0 V to 34.6 V rms). Rear panel LINE AUDIO LEVEL potentiometer R1 establishes the level.

2. SIGNAL STRENGTH. This indication is related to the AM detector voltage. In AGC modes it provides a logarithmic indication of signal strength; in the manual gain mode it represents a near linear indication of AM detector voltage.

2.4.4 GAIN MODE

The following switches establish the receiver gain mode.

1. FAST AGC. The 15 ms response time provided in this mode is useful for AM and FM signals.

2. SLOW AGC. The 15 ms attack time and 2 sec decay time provided in this mode is suitable for CW, ISB, and SSB signals.

3. MAN GAIN. This mode activates the RF GAIN control which otherwise has no effect. If the AM detector is overloaded in the MAN gain mode, switching to the SLOW AGC mode may result in a recovery time several times longer than expected for the SLOW AGC mode.

2.4.5 RF GAIN CONTROL

When in the MAN gain mode, rotating the RF GAIN control clockwise approximates a logarithmic increase in receiver gain. With the METER switches in the SIGNAL STRENGTH mode, this control should be set for an indication at the MAN SET mark on the meter.

2.4.6 DETECTION MODE

One of the following six detection switches must be depressed to establish a detection mode. If the AM, FM, or CW switch is selected, an IF BANDWIDTH kHz switch also must be selected. Selection of optional ISB, USB, or LSB switches automatically activates other bandwidth filters related to these modes of operation.

1. AM MODE. The LINE AUDIO, PHONE AUDIO, and front panel PHONES audio are taken from the AM detector in this mode.

2. FM MODE. The LINE AUDIO, PHONE AUDIO, and front panel PHONES audio are taken from the FM detector in this mode. A dc-coupled monitor voltage from the detector appears at the FM AUDIO terminals of TB2 for test purposes.

3. CW MODE. Selection of this mode enables the BFO and the BFO offset switch. The LINE AUDIO, PHONE AUDIO, and front panel PHONES audio are taken from the CW/SSB product detector in this mode.

4. USB MODE (Option). Selection of this mode overrides the front panel IF bandwidth switches and activates the independent IF filter for upper sideband reception. Audio will be available at the front panel PHONES jack, and at the AUDIO LINE terminals and PHONE AUDIO terminals of TB1 on the rear panel. The BFO is enabled but fixed in frequency at 455 kHz. The frequency readout indicates the corresponding suppressed carrier frequency.

5. LSB MODE (Option). Except for the sideband selected, this mode is functionally identical to the USB mode.

6. ISB MODE (Option). Selection of this detection mode automatically activates separate IF filters independent of the front panel IF bandwidth selection. Both upper and lower sidebands are separately and simultaneously demodulated.

   The stereo PHONES jack provides the USB component of the signal on the tip contact and the LSB component of the signal on the ring contact. With mono headphones, only the USB component of the signal will be heard.

   On the rear panel, lower sideband information will be available at the ISB AUDIO terminals of TB2. Upper sideband information will be available at the AUDIO LINE terminals of TB1.

2.4.7 IF BANDWIDTH (kHz)

One of the following IF bandwidth switches must be selected when in the AM, FM, or CW detection modes; in the other three detection modes IF bandwidth switches are inoperative. Available bandwidths are: 0.3 kHz, 1.0 kHz, 3.2 kHz, 6 kHz, and 16 kHz.

2.4.8 BFO OFFSET

These thumbwheel switches are activated only in the CW detection mode. The BFO offset is 8.9 kHz (from 455 kHz) in steps of 100 Hz. The BFO signal is injected after the IF bandwidth filters, thus ensuring that the pitch is independent of IF bandwidth. Switching to "0" of the "+, 0, -" section of the switch automatically tunes the BFO to 455 kHz, regardless of the setting of the numerical sections.

2.4.9 TUNED FREQUENCY READOUT

This seven-digit readout displays the tuned frequency of the receiver. Each digit is a seven-segment LED with intensity controlled by a single potentiometer located inside the receiver. The least-significant digit, at the far right, indicates 10's of Hz. Tuned frequency is displayed for both local and remote control of the receiver.

2.4.10 MANUAL TUNING MODULE (A7)

The tuned frequency of the receiver is controlled from the front panel. On versions of the receiver not including the Manual Tuning Module, remote inputs on the rear panel establish tuned frequency. For these remote control receivers, the IF bandwidths may also be selected from the remote location.

1. TUNING KNOB. Rotating the knob clockwise increases tuned frequency; counterclockwise rotation decreases tuned frequency. Continuing to tune past the end of the range causes the receiver to step to the opposite end of the band and to continue tuning in the same increasing or decreasing frequency direction. The receiver tunes from 00.00000 MHz to 29.99999 MHz, useable above 5 kHz.

2. TUNING DISABLE. Engaging this button locks the receiver to the frequency currently being displayed. Any other tuning-related button engaged will be released and the tuning knob disabled. Also, by engaging this button, the receiver may be tuned remotely, if this option is installed. Depressing any tuning button slightly releases all buttons and also disables tuning.

3. 10 kHz BUTTON. With this button engaged, only the four most-significant digits of the readout can be varied by the tuning knob. The 1 kHz, 100 Hz, and 10 Hz digits will be locked to the frequency indicated when the 10 kHz button was engaged.

4. 1 kHz BUTTON. With this button engaged, the five most-significant digits of the readout can be varied by the tuning knob. The two least-significant digits will be locked to a fixed frequency.

5. 100 Hz BUTTON. With this button engaged, only the 10 Hz digit is locked to frequency. All others are available for tuning.

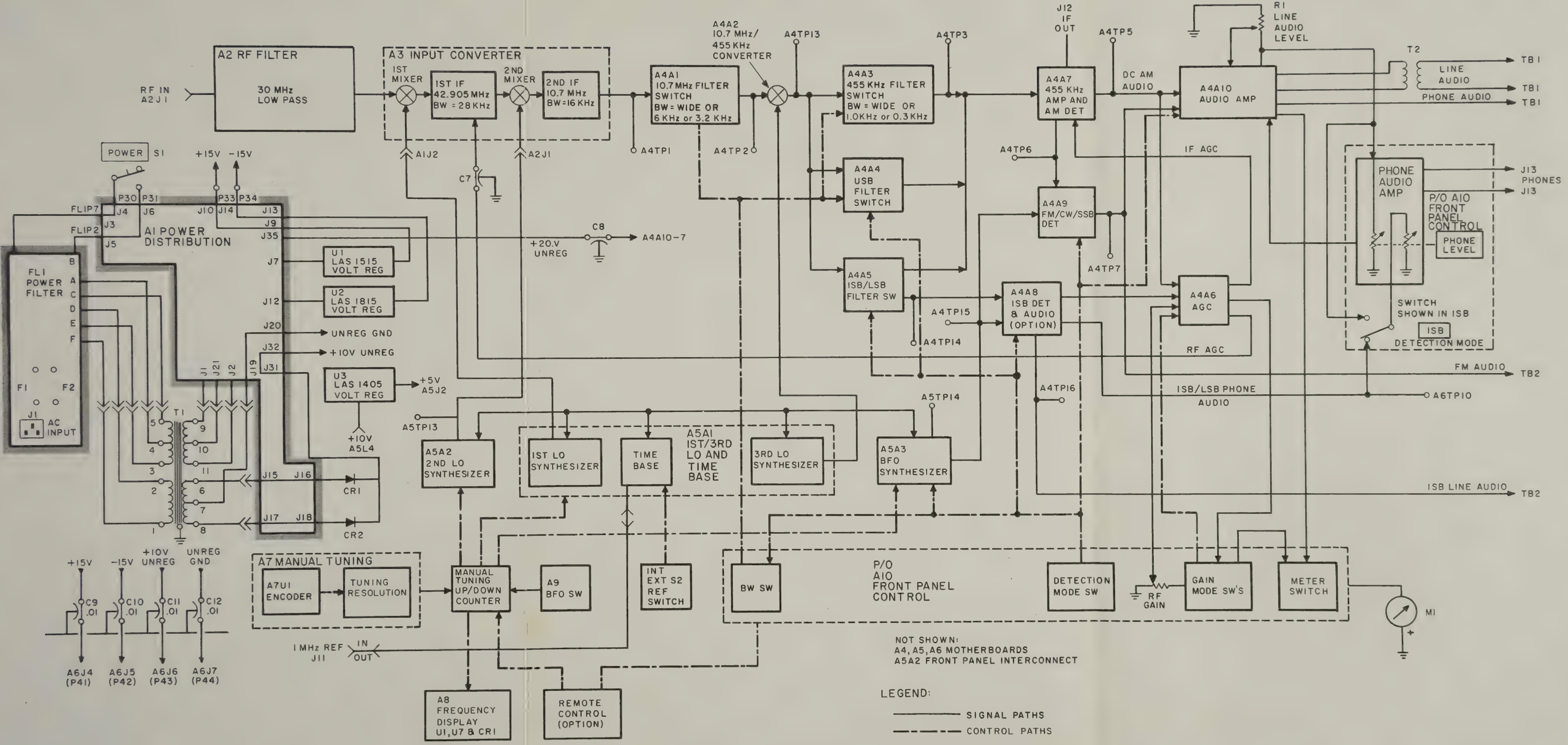
6. 10 Hz BUTTON. With this button engaged, all digits are available for tuning.

2.4.11 PHONE LEVEL CONTROL

Rotating the front panel PHONE LEVEL control clockwise increases the output of both the PHONE AUDIO terminals at TB2 and the stereo PHONES jack on the front panel.

THIS PAGE LEFT BLANK

THIS PAGE LEFT BLANK



NOT SHOWN:
A4, A5, A6 MOTHERBOARDS
A5A2 FRONT PANEL INTERCONNECT

LEGEND:
——— SIGNAL PATHS
–·–·– CONTROL PATHS

Figure 3-1. WJ-8718 Overall Block Diagram

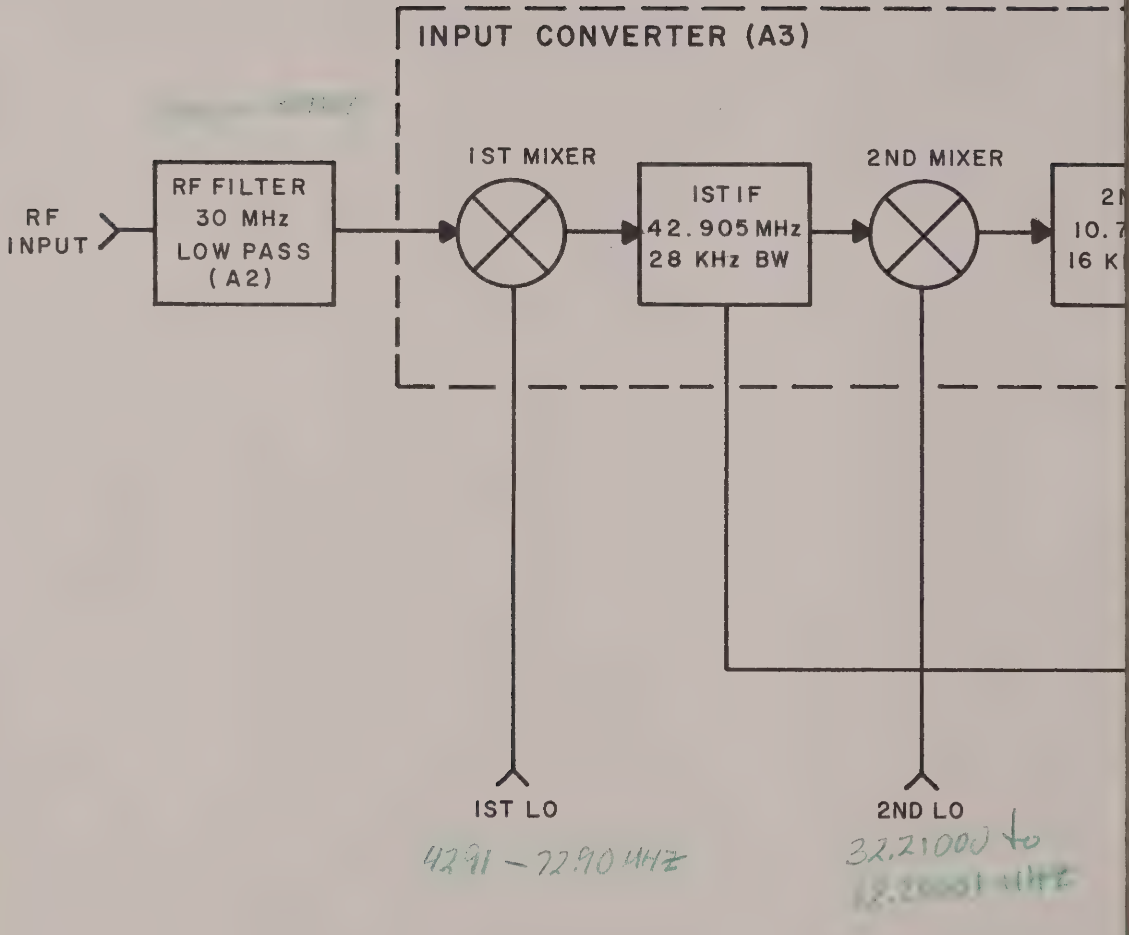


Figure 3-2. Receiver Section, Functional Block Diagram

SECTION III

CIRCUIT DESCRIPTION

3.1 GENERAL

This section describes the various circuits of the WJ-8718 HF Receiver. For coherence in description, the receiver is divided into four functional sections: receiver, synthesizer, digital control, and power supply. A functional description precedes detailed descriptions of the four functional sections. The discussions of the receiver, synthesizer, digital control, and power supply sections consist of circuit descriptions introduced by detailed functional descriptions. Functional block diagrams are included where required. This section is arranged in a functional sequence rather than a numerical sequence to facilitate progressive reading. The table of contents should be consulted for locating descriptions of specific circuits. It is assumed that the reader of this section is familiar with the preceeding sections of this manual.

The unit numbering method is used for identification of electrical components in this receiver. Each circuit board or assembly part carries a prefix before the usual class letter and item number. For example, the full designation for R1 on circuit board A4 is A4R1. Paragraph 5.1 should be consulted for further understanding of the unit numbering method. These prefixes are omitted on illustrations and in text except where necessary to avoid confusion.

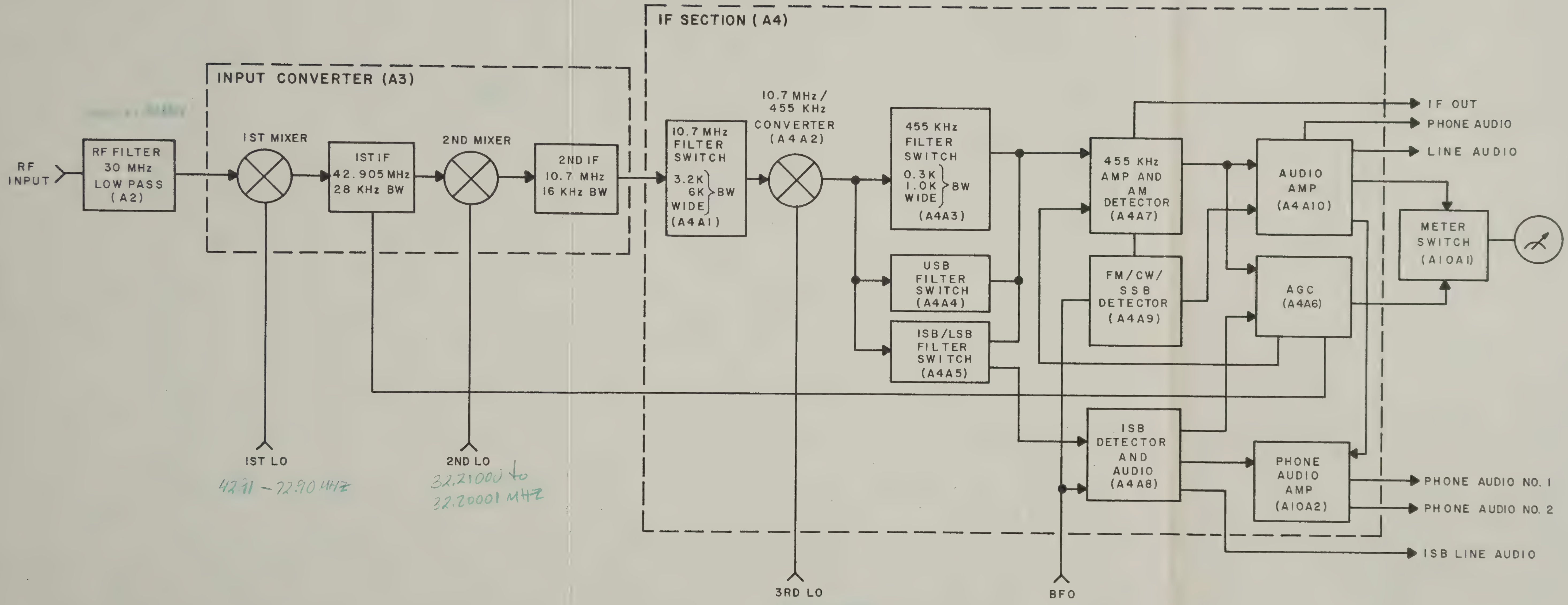
3.1.1 OVERALL DESCRIPTION

The WJ-8718 Receiver, shown in Figure 3-1, is a triple-conversion, superheterodyne receiver which operates in the frequency range from 5 kHz to 30 MHz. It has selected bandwidths between 0.3 kHz and 16 kHz and demodulators for AM, FM, and CW signals. Sideband reception (ISB, LSB, and USB) is available as an option. Tuning is in discrete 10 Hz steps, locked by frequency synthesizers to an internal or external frequency standard for accuracy and stability. The power supply section provides regulated voltages of +15 V, -15 V, and +5 V.

3.2 RECEIVER SECTION

3.2.1 FUNCTIONAL DESCRIPTION

Refer to the receiver functional block diagram, Figure 3-2. Signals enter the receiver via the RF IN connector on the rear panel. The RF Filter accepts signals between 5 kHz and 30 MHz. These signals are passed to the Input Converter, which includes the 1st Mixer, 1st IF Amplifier, 2nd Mixer, and a portion of the 2nd IF Amplifier. The 16 kHz bandwidth of the Input Converter is determined by a crystal filter in the 2nd IF Amplifier. The signals within this bandwidth enter the 10.7 MHz Filter Switch which contains two crystal filters and a wide bandwidth signal path, all of which are selectable. In the 10.7 MHz/455 kHz Converter, the signal is converted to the 3rd IF frequency. This signal is then applied in parallel to the 455 kHz Filter Switch, and (if they are installed) the optional USB Filter Switch and optional ISB/LSB Filter Switch. In the 455 kHz Filter Switch are two more crystal filter paths, 1.0 kHz and 0.3 kHz bandwidth and a wideband path to the 455 kHz Amplifier and AM Detector. In the optional USB Filter Switch is a 2.95 kHz wide crystal filter centered above 455 kHz for upper sideband reception. The optional ISB/LSB Filter Switch has a similar filter centered below 455 kHz for lower sideband reception. Table 3-1 shows how these filters are used to control the receiver bandwidth when various bandwidths and detection modes are selected.


RF INPUT
RF FILTER 30 MHz LOW PASS (A2)
INPUT CONVERTER (A3)
1ST MIXER
1ST IF 42.905 MHz 28 KHz BW
2ND MIXER
2ND IF 10.7 MHz 16 KHz BW
1ST LO
2ND LO
IF SECTION (A4)
10.7 MHz FILTER SWITCH 3.2K 6K WIDE BW (A4A1)
10.7 MHz / 455 KHz CONVERTER (A4A2)
3RD LO
455 KHz FILTER SWITCH 0.3K 1.0K WIDE BW (A4A3)
USB FILTER SWITCH (A4A4)
ISB/LSB FILTER SWITCH (A4A5)
455 KHz AMP AND AM DETECTOR (A4A7)
FM/CW/SSB DETECTOR (A4A9)
ISB DETECTOR AND AUDIO (A4A8)
BFO
AUDIO AMP (A4A10)
AGC (A4A6)
PHONE AUDIO AMP (A10A2)
METER SWITCH (A10A1)
IF OUT
PHONE AUDIO
LINE AUDIO
PHONE AUDIO NO. 1
PHONE AUDIO NO. 2
ISB LINE AUDIO

42.91 – 72.90 MHz

32.21000 to
32.20001 MHz

11.15500 MHz.

Figure 3-2. Receiver Section, Functional Block Diagram

SECTION III

CIRCUIT DESCRIPTION

3.1 GENERAL

This section describes the various circuits of the WJ-8718 HF Receiver. For coherence in description, the receiver is divided into four functional sections: receiver, synthesizer, digital control, and power supply. A functional description precedes detailed descriptions of the four functional sections. The discussions of the receiver, synthesizer, digital control, and power supply sections consist of circuit descriptions introduced by detailed functional descriptions. Functional block diagrams are included where required. This section is arranged in a functional sequence rather than a numerical sequence to facilitate progressive reading. The table of contents should be consulted for locating descriptions of specific circuits. It is assumed that the reader of this section is familiar with the preceeding sections of this manual.

The unit numbering method is used for identification of electrical components in this receiver. Each circuit board or assembly part carries a prefix before the usual class letter and item number. For example, the full designation for R1 on circuit board A4 is A4R1. Paragraph 5.1 should be consulted for further understanding of the unit numbering method. These prefixes are omitted on illustrations and in text except where necessary to avoid confusion.

3.1.1 OVERALL DESCRIPTION

The WJ-8718 Receiver, shown in Figure 3-1, is a triple-conversion, superheterodyne receiver which operates in the frequency range from 5 kHz to 30 MHz. It has selected bandwidths between 0.3 kHz and 16 kHz and demodulators for AM, FM, and CW signals. Sideband reception (ISB, LSB, and USB) is available as an option. Tuning is in discrete 10 Hz steps, locked by frequency synthesizers to an internal or external frequency standard for accuracy and stability. The power supply section provides regulated voltages of +15 V, -15 V, and +5 V.

3.2 RECEIVER SECTION

3.2.1 FUNCTIONAL DESCRIPTION

Refer to the receiver functional block diagram, Figure 3-2. Signals enter the receiver via the RF IN connector on the rear panel. The RF Filter accepts signals between 5 kHz and 30 MHz. These signals are passed to the Input Converter, which includes the 1st Mixer, 1st IF Amplifier, 2nd Mixer, and a portion of the 2nd IF Amplifier. The 16 kHz bandwidth of the Input Converter is determined by a crystal filter in the 2nd IF Amplifier. The signals within this bandwidth enter the 10.7 MHz Filter Switch which contains two crystal filters and a wide bandwidth signal path, all of which are selectable. In the 10.7 MHz/455 kHz Converter, the signal is converted to the 3rd IF frequency. This signal is then applied in parallel to the 455 kHz Filter Switch, and (if they are installed) the optional USB Filter Switch and optional ISB/LSB Filter Switch. In the 455 kHz Filter Switch are two more crystal filter paths, 1.0 kHz and 0.3 kHz bandwidth and a wideband path to the 455 kHz Amplifier and AM Detector. In the optional USB Filter Switch is a 2.95 kHz wide crystal filter centered above 455 kHz for upper sideband reception. The optional ISB/LSB Filter Switch has a similar filter centered below 455 kHz for lower sideband reception. Table 3-1 shows how these filters are used to control the receiver bandwidth when various bandwidths and detection modes are selected.

Table 3-1. Receiver IF Bandwidth Relationships

Selected Detection Mode	Selected Receiver Bandwidth	10.7 MHz IF Filter Bandwidth	455 kHz IF Filter Bandwidth
AM, FM, or CW	16 kHz	16 kHz	16 kHz
	6 kHz	6 kHz	16 kHz
	3.2 kHz	3.2 kHz	16 kHz
	1.0 kHz	16 kHz	1.0 kHz
	0.3 kHz	16 kHz	0.3 kHz
USB	BANDWIDTHS ARE FIXED IN THESE MODES	16 kHz	USB (2.95 kHz)
LSB		16 kHz	LSB (2.95 kHz)
ISB		16 kHz	USB + LSB

NOTE: The Input Converter Bandwidth is 16 kHz.

From the output of the 455 kHz filters, the signal flow and circuit operation are controlled by the Detection Mode switches, whose functions are summarized in Table 3-2. For all detection modes, a filtered 455 kHz signal is sent to the 455 kHz Amplifier/AM Detector. In all detection modes the AM detector output is processed by the AGC and used for Signal Strength Meter voltage and, in AGC mode, used for RF and IF gain control.

In the AM mode, the AM detector supplies AM audio through part of the Audio Amplifier (to the Phone Level Control) and the Line Audio Level control on the rear panel.

In the FM mode, the limiter and discriminator portion of the FM/CW/SSB Detector energizes and receives an amplified 455 kHz signal from the 455 kHz Amplifier. FM audio then passes through the Audio Amplifier, as well as the Phone Level and Line Audio Level controls.

In the CW mode, and optional USB and LSB modes, the BFO and the product detector portion of the FM/CW/SSB Detector are enabled and use the amplified 455 kHz signal as indicated in Figure 3-2. The product detector audio output passes through the Audio Amplifier to the phone level and line audio level controls.

In the optional ISB mode, the circuits described above operate the same as for the USB mode. In addition, the LSB signal is fed to the ISB Detector and Audio which duplicates portions of the 455 kHz amplifier, product detector, AGC, and audio amplifier circuits. LSB audio is applied to the ISB audio level control and one section of the phone level control. The other section of the phone level control is still supplied with USB audio. As a result, the PHONES jack on the front panel, which is a three-conductor type, will have both USB and LSB audio available in the ISB mode if suitable headphones (i.e., 600 Ω, "stereo" type) are used. For all other detection modes the Phone Audio will be available at the PHONES jack.

Table 3-2. Detection Mode Output Signal Relationships

DETECTION MODE	AM DET	FM DET	CW DET & BFO	LINE AUDIO SIGNAL	ISB AUDIO SIGNAL
AM	ON	OFF	OFF	AM	OFF
FM	ON	ON	OFF	FM	OFF
CW	ON	OFF	ON	CW	OFF
USB	ON	OFF	ON	USB	OFF
LSB	ON	OFF	ON	LSB	OFF
ISB	ON	OFF	ON	USB	LSB

3.2.2 TYPE 791616 RF FILTER (A2)

The first module in the receiver's signal path is a 15-pole, low-pass RF Filter, whose schematic is shown in Figure 6-1. It restricts the signals entering the receiver to the intended frequency band of 5 kHz to 30 MHz. Over this frequency range, its attenuation is less than 1 dB, rising slightly at the ends of the range. Above 30 MHz, the attenuation increases rapidly. This stopband attenuation determines the image rejection and the conducted LO leakage of the receiver. Without this attenuation, the receiver would have full sensitivity to signals in the image frequency band between 85.8 MHz and 115.8 MHz. Also, the 1st LO, which tunes from 42.9 MHz to 72.9 MHz would have an easy path from the 1st Mixer, which follows the RF Filter, to the RF IN connector where it could become an RFI source. However, over both of these frequency bands, the filter attenuation is greater than 80 dB. The RF Filter also protects the rest of the receiver from damage due to excessive signal levels in the filter passband. Diodes CR1, CR2, VR1, and VR2 conduct when signals greater than +15 dBm enter the RF IN connector, shunting the excessive energy away from the receiver. Resistor R1 provides a dc path to discharge any static electric charge which might exist at the RF input.

The values of inductors and capacitors are critical to the filter performance and close tolerance parts are used. Care must be taken if it becomes necessary to open the RF Filter enclosure since the physical orientation of the parts, particularly the inductors, affect both its passband and stopband response.

3.2.3 TYPE 791592 INPUT CONVERTER (A3)

All signals entering the Input Converter from the RF Filter are converted up in frequency and filtered. Signals passed by the 1st IF Filter are amplified and converted down in frequency to 10.7 MHz. Here they are further amplified and filtered. The overall net gain of the Input Converter is roughly +12 dB when zero gain control current is applied. The schematic diagram of the Input Converter is shown in Figure 6-2.

Signals reaching the 1st Mixer, A1U1, may be any frequency from 5 kHz up to slightly above 30 MHz and any level from the noise floor to +30 dBm. In general, many signals will be present covering a wide range of levels. The role of the 1st Mixer is to handle these in such a way that the balance of the receiver can select the desired signal and reject all others. To accomplish this, a high level mixer is used and relatively high (+20 dBm) local oscillator power is applied. The conversion loss of the 1st Mixer is approximately 6 dB. Therefore, the 1st Mixer is followed by an amplifier to restore the signals to their original levels. This amplifier uses a grounded gate FET, A1Q2, to obtain a low noise figure, a good terminating impedance for the mixer, and a large signal handling ability. To set the operating point of A1Q2, a constant current source, A1Q1 and its associated circuitry, is used. Due to the

3.2.2a TYPE 791616 RF INPUT FILTER (A2)

Within this assembly is a Type 280093 P C board which contains the circuitry of the RF input filter. The schematic diagram for this circuit is Figure 6-8a. The circuit is a 10-pole, elliptic function low-pass RF filter, with an insertion loss of less than 1.5 dB over the normal input range of 0.5 to 30 MHz. Above 30 MHz, the attenuation increases rapidly. This attenuation improves the image rejection and reduces the conducted LO leakage of the receiver. Over the range of LO and image frequencies, the attenuation of the input filter exceeds 80 dB. Resistor R1 provides a dc path to ground to bleed off any accumulated static charge at the RF input. Diodes CR1 through CR4 use the Zener breakdown potential to protect the rest of the receiver from input signals in excess of +15 dBm. C12 and L6 provide a high frequency trap to prevent radiation of harmonics of the 1st LO. The nominal input impedance of the filter is 50Ω.

THIS PAGE LEFT BLANK

variation between FET's, the effects of temperature, and other conditions of the circuit, the dc voltage at the collector of A1Q1 and the source of A1Q2 may range from about 0.5 V to greater than 3 V.

The output load for A1Q2 is transformer A1T1 which is broadly tuned by A1C3 to ensure a proper driving impedance for the 1st IF crystal filter A1FL1. This filter requires a 50 Ω source and load and has a center frequency of 42.905 MHz and a 3 dB bandwidth of 28 kHz. The primary function of A1FL1 is to reject unwanted signals which are passed by the RF Filter and 1st Mixer and to establish the initial IF bandpass.

Signals passed by A1FL1 are coupled to a second amplifier, A2Q2, through a coupling network consisting of L1 and A2C11. This amplifier is very similar to A1Q2 and has a similar constant current source biasing it. Its output circuit is also a broadly tuned transformer, but is shunted by gain control diode A2CR2. As the current through the diode increases, its RF impedance decreases and the net gain of A2Q2 is decreased. Current to A2CR2 is supplied by the RF Gain portion of the AGC, A4A6. As the current varies from zero to maximum, there is approximately 30 dB of gain reduction.

The output signal of A2Q2 is down converted by the 2nd Mixer, A2U1. The 2nd LO signal enters the Input Converter via A2J1 at a level of approximately 0 dBm. Common emitter amplifiers, A2Q5 and A2Q6, provide enough gain to bring the 2nd LO signal to a nominal level of +17 dBm. Each of these stages is broadly tuned transformer-coupled and each has some unbypassed emitter resistance to preserve a relatively low harmonic content in the 2nd LO signal.

The 2nd Mixer is followed by a bipolar cascode amplifier. It consists of common emitter stage A2Q4 and common base stage A2Q3. These provide relatively high gain with good stability and low noise contribution. Transformer A2T2 couples the output of A2Q3 to crystal filter A2FL1. This filter has a center frequency of 10.7 MHz, a bandwidth of 16 kHz, and requires 50 Ω terminations.

The received signal frequency which corresponds to the center of the 2nd IF at exactly 10.7 MHz depends on the frequencies of both the 1st and 2nd LO's. The control of these two oscillators is described in the Synthesizer Section 3.3.

3.2.4 TYPE 791569 IF MOTHERBOARD (A4)

The schematic diagram of the IF Motherboard can be found on the main chassis schematic diagram, Figure 6-22. The IF Motherboard has 11 positions for plug-in circuit cards. With the ISB option installed, a total of 10 positions are used and the eleventh is a spare.

3.2.5 TYPE 791594 10.7 MHz FILTER SWITCH (A4A1)

The 10.7 MHz Filter Switch has two basic functions: it selects one of three signal paths as part of the overall receiver bandwidth determining scheme and it provides additional IF amplification. The schematic diagram of this module is shown in Figure 6-3.

All six transistors, Q1 through Q6, act as switches and amplifiers. Only two will be on at a time. When Q1 and Q2 are biased on, the 3.2 kHz crystal filter FL1 is engaged, restricting the receiver bandwidth to that value. When Q3 and Q4 are on, FL2 is active, giving the receiver a 6.0 kHz bandwidth. The path through Q5 and Q6 is quite broad, so when they are selected, the receiver bandwidth through at least the 2nd IF is controlled by the Input Converter at 16 kHz. The pair of transistors switched on is determined by the voltage on the

3.2.5a TYPE 791594 10.7 MHz FILTER SWITCH (A4A1) (REVISION E)

The schematic diagram for this circuit board is Figure 6-3a. The 10.7 MHz Filter Switch receives the 10.7 MHz IF signal output from the Input Converter, A3. A block diagram of the IF section is shown in Figure 3-2. At this point, the IF bandwidth has been set at 16 kHz by a filter in the Input Converter. The 10.7 MHz Filter Switch contains bandpass filters of 6 kHz and 3.2 kHz bandwidth. The purpose of this circuit is to route the IF signal through one of these filters, or through a wideband path which allows the full 16 kHz bandwidth to pass. The selection of the filter path is made by application of a logic high level to one of the three control terminals.

In any IF bandwidth, a logic high is applied to one of three control lines from the I/O motherboard, at pin 15, 17, or 19. These lines are connected to the non-inverting inputs of U1A, U1B, and U2A. The inverting inputs are held at approximately 0.8 V by voltage divider R52-R53. The output voltage of the selected op-amp swings positive, turning on one pair of common-emitter IF amplifier stages. For example, if U1A is selected, Q1 and Q4 are turned on.

The 10.7 MHz IF signal is input at pin 13 and coupled through C1 to the base circuits of Q1, Q2, and Q3. If Q1 is on, the signal is amplified and coupled to FL1. This filter has a 50 Ω input impedance and a 3 dB bandwidth of 3.2 kHz. The filtered IF signal is applied to amplifier Q4 through level-adjust potentiometer R26. The amplified IF signal is output at pin 57. If 6 kHz bandwidth is selected, the IF signal is routed through Q2, FL2, and Q5. If any other bandwidth is selected, the IF signal is routed through Q3, attenuator R22, R23, R24, and Q6. The gain of the three signal paths is equalized by R26, R28, and R30 to approximately 14 dB. The circuit has nominal input and output impedances of 50Ω.

THIS PAGE LEFT BLANK

three control lines: pins 15, 17, and 19 of this module. Zero volts turns off a signal path while +5 V turns it on. The source of these control voltages will be discussed in the Digital Control Section 3.4.

A signal entering this module from the Input Converter will pass through a reactive impedance transformer consisting of C31 and L2 which provides the required 50 Ω termination for the output filter of the Input Converter. The signal is applied in parallel to the inputs of Q1, Q3, and Q5. If Q1 or Q3 is on, the signal will be amplified and transformer coupled to the corresponding crystal filter. If Q5 is on, the signal is amplified but not filtered. Potentiometers R7, R22, and R39 serve to equalize the gain (approximately 14 dB) of the three signal paths. The signal passes through the corresponding output transistor, Q2, Q4, or Q6, whose output feeds another reactive impedance transformer consisting of L3 and C32.

In normal operation, one pair of transistors is always on. The transistors with +5 V applied to their control gate (pin 2) will conduct, causing approximately 2 V drop across R34 and R45 which serves to cut off the transistors with zero pin 2 voltage. In the event that no bandwidth selection is made, all three control voltages will be zero and some signal may leak through these paths, but the receiver will appear dead due to further switching which occurs in the 3rd IF.

3.2.6 TYPE 71430 10.7 MHz/455 kHz CONVERTER (A4A2)

The schematic diagram for this converter is shown in Figure 6-4. The 3rd Mixer converts signals from 10.7 MHz to 455 kHz. The 3rd LO signal is input at the fixed frequency of 11.155 MHz and a level of approximately -6 dBm, and is amplified by transistor Q1 and its associated circuitry to roughly +7 dBm before entering the mixer. The amplifier operates as a common emitter stage with some unbypassed emitter resistance to stabilize its gain and reduce distortion. The pi-network, C7-L2-C8, serves as an impedance transformer and low-pass filter, further reducing distortion of the LO signal.

Low-pass filter C9, L3, C10, L4, and C11 filters out undesired components above 500 kHz from the mixer output and matches impedances between the mixer and the following circuits. The sideband structure of the 455 kHz signal is a replica of those which entered the receiver at the RF IN connector. This is not true of the 1st and 2nd IF signals. When a mixer generates an IF frequency which is the difference between an input signal frequency and local oscillator of higher frequency than the input signal, the output has a sideband spectrum which is reversed from the input. Therefore, if a single sideband signal is received which is transmitted as upper sideband, upon reaching the 1st IF the signal would appear to be a lower sideband one. In the 2nd Mixer, the LO is below that mixer input frequency, no additional spectral reversal occurs and the 2nd IF signal would also appear to be a lower sideband one. Finally, in the 3rd Mixer, another spectral reversal occurs and the signal again appears as an upper sideband one. This matters primarily when troubleshooting by injecting IF test signals. When a signal is injected into the 1st or 2nd IF, if its frequency is increased, the frequency of the 3rd IF signal will appear to decrease. Remember, however, there is no apparent reversal from the RF input to the 3rd IF.

3.2.7 TYPE 791595 455 kHz FILTER SWITCH (A4A3)

The schematic diagram for this circuit is Figure 6-5. The 3rd IF signal from the 10.7 MHz/455 kHz converter is fed in parallel to the 455 kHz Filter Switch, A4A3, the optional USB Filter Switch, A4A4, and the optional ISB/USB Filter Switch A4A5. The USB Filter Switch and ISB/LSB Filter Switch have relatively high input and output impedances. Therefore, there is no change in the operation of the 455 kHz Filter Switch if the options are not installed.

The 455 kHz Filter Switch is similar in function to the 10.7 MHz Filter Switch. Both contain three possible signal paths, two with crystal filters and one with broad bandwidth. There are, however, several important differences between the two filter switches. The 455 kHz bandwidth is 0.3 kHz when Q1 and Q2 are activated, and 1 kHz when Q3 and Q4 are activated. When Q5 and Q6 are activated the broad bandwidth path is energized, thus allowing the overall receiver bandwidth to be controlled by the 10.7 MHz Filter Switch or the Input Converter. In the 455 kHz Filter Switch it is possible for all paths to be off when the USB or LSB filters are selected.

The input signal connects in parallel to Q1, Q3, and Q5. When Q1 is biased on, the signal passes through Q1 and is fed through the 0.3 kHz crystal filter (FL1). The biasing of Q1 and Q2 is controlled by the voltage on pin 19. When this voltage is high (+5 V), the output of U1D will be +12 V to +15 V, thus biasing Q1 and Q2. When this voltage is low (0 V), the output of U1D will be -12 V to -15 V which will cause an approximate 1 V reverse bias to the bases of Q1 and Q2, and thus they are turned off.

When the 1 kHz bandwidth is selected, module pin 17 is high, and U1A turns on Q3 and Q4. When the 3.2 kHz, 6 kHz, or 16 kHz bandwidths are selected, module pin 15 is high and U1B turns on Q5 and Q6. When ISB, LSB, or USB are selected, all three control lines to this card are low and all three signal paths are inhibited.

All transistors, Q1 through Q6, are operated as common emitter amplifiers with unbypassed emitter resistors to control their gain. Through any of the three signal paths there is a net voltage gain of approximately 9 dB from the input to the output of the module. OP AMP section U1C is not used and is as shown in the schematic connected in an inoperative condition.

3.2.8 TYPE 791596 USB FILTER SWITCH OPTION (A4A4)

The schematic diagram for this circuit description is shown in Figure 6-6. The USB Filter Switch is connected in parallel with the 455 kHz Filter Switch at both the input and the output. It functions like a single channel of the other Filter Switch modules previously mentioned. The USB Filter passes signals between 455.25 kHz and 458.2 kHz and amplifies with a net voltage gain of approximately 9 dB. Because the passband of the filter is offset above the center of the 3rd IF, this filter passes only the upper sideband information when the receiver is tuned to a signal's carrier frequency. This signal path is enabled when either the USB or ISB detection mode is selected. The USB or ISB detection mode inhibits the operation of the 455 kHz Filter Switch.

The input signal is applied to Q1, which either amplifies it or blocks it depending on the voltage on gate 2. The sources of Q1 and Q2 are both connected to a stable +1.5 V supplied by diodes CR1 through CR3. When pins 49 or 51 are high, gate 2 of both transistors have approximately +4.5 V applied, turning them on. When these control voltages are low (0 V), both transistors are off. Potentiometer R11 is used to adjust the net gain of the signal path for equalization with the gain of the 455 kHz Filter Switch.

3.2.9 TYPE 791597 ISB/LSB FILTER SWITCH OPTION (A4A5)

The schematic diagram for this circuit description is Figure 6-7. The ISB/LSB Filter Switch connects in parallel with the 455 kHz Filter Switch although the ISB/LSB Filter Switch has an additional output. This output feeds into the ISB Detector/Audio module. The LSB filter is offset below the center of the 3rd IF, passing signals between 451.8 kHz and

3.2.8a TYPE 791596 USB FILTER SWITCH (A4A4) (REVISION G)

The schematic diagram for this circuit board is Figure 6-6a. The USB Filter Switch connects into the 455 kHz IF signal path, in parallel with the 455 kHz Filter Switch. A block diagram of the IF section is shown in Figure 3-2. When the receiver is operating in either the USB mode or the ISB mode, the upper sideband modulation is passed in this circuit and sent to the 455 kHz Amplifier/AM Detector (A4A7). The upper sideband filter (FL1) has a bandpass extending from 455.25 kHz to 458.2 kHz.

When either the USB or ISB detection mode is selected, a logic high is applied to the non-inverting input of U1A. This causes its output voltage to swing to near +15 V. The switching threshold (approximately 1.6 V) is set by R17 and R18. The positive output voltage supplies bias current to amplifiers Q1 and Q2, turning them on. The 455 kHz IF signal, with 16 kHz bandwidth, is amplified by Q1 and applied to the upper sideband filter, FL1. The upper sideband is amplified by Q2 and output via pin 57. Potentiometer R23 provides gain adjustment for equalizing the USB signal level with the other filtered IF signals. Resistors R7 and R8 provide impedance matching for the filter input and output, respectively.

3.2.9a TYPE 791597 ISB/LSB FILTER SWITCH (A4A5) (REVISION E)

The schematic diagram for this circuit board is Figure 6-7a. The ISB/LSB Filter Switch connects into the 455 kHz IF signal path, in parallel with the 455 kHz Filter Switch. A block diagram of the IF section is shown in Figure 3-2. The circuit has two signal outputs, one to the 455 kHz Amplifier/AM Detector (A4A7), and one to the ISB Detector and Audio (A4A8). When the receiver is operating in the LSB detection mode, the lower sideband modulation is output to the 455 kHz Amplifier/AM Detector (A4A7). When the receiver is in the ISB detection mode, the lower sideband modulation is output to the ISB Detector and Audio board. The lower sideband filter (FL1) has a bandwidth extending from 451.8 kHz to 454.75 kHz.

When the LSB Detection mode is selected, a logic high is applied to the non inverting input of U1A. This causes the output voltage to swing to near +15 V. The switching threshold (approximately 2.5 V) is set by R23 and R24. Diode CR1 conducts, supplying bias current through R15 to turn on IF amplifier Q1. Output amplifier Q2 is also biased on, by current flow in R21 and R9. The 455 kHz IF signal, with 16 kHz bandwidth, is amplified by Q1 and applied to the lower sideband filter, FL1. The lower sideband is amplified by Q2 and output via pin 57.

When ISB detection mode is selected, Q1 is biased on by U1B and CR2, as previously described. Output amplifier Q3 is also biased on by current flow in R26 and R27. The lower-sideband information is amplified by Q3 and output via pin 53. Notice that only one output amplifier is operating in either mode. Potentiometer R32 allows gain adjustment for equalizing the filtered IF signal levels. Resistor R8 provides input impedance matching for the filter, and the output impedance is matched by R9 and R27.

454.75 kHz. This corresponds to the lower sideband information of a signal whose carrier frequency equals the receiver's dial frequency.

When the LSB detection mode is selected, the signal path through Q1, FL1, and Q2 is enabled and the LSB output flows to the same point as does the signal from the USB Filter Switch or the 455 kHz Filter Switch. When the optional ISB detection mode is selected, the enabled signal path consists of Q1, FL1, and Q3. In this case the LSB signal is sent instead to the ISB detector. Therefore, in ISB operation the USB Filter Switch and LSB Filter Switch act as active signal splitters. Both receive the same composite signal and filter it, sending the selected information to their respective paths for amplification and demodulation. The operation of the FET switch circuits is essentially identical to that described for the USB Filter Switch. Potentiometer R11 equalizes the LSB signal gain (approximately 9 dB).

3.2.10 TYPE 72488 455 kHz AMPLIFIER/AM DETECTOR (A4A7)

The schematic diagram for this circuit description is Figure 6-9. Although received signals are amplified by most of the circuits in the receiver, the majority of the amplification of weak signals takes place in the 455 kHz amplifier of A4A7. Following a two-stage gain controlled amplifier, the input signal is split to provide three outputs: the IF sample which operates the FM/CW/SSB Demodulator, the IF output for the rear panel, and the input to the AM Detector. The AM Detector, which operates at a relatively high level for good linearity, has its output directly coupled to the AGC module and the Audio Amplifier.

FET's Q1 and Q2 operate as common source amplifiers with their gains controlled by a variable voltage applied to gate 2 of each transistor. Inductor L1 broadly tunes the output of Q1 by cancelling any stray capacitance, but the network consisting of L2, C9, C10, C11, and L3 forms a double-tuned bandpass filter of approximately 35 kHz bandwidth. This filter is narrow enough to suppress any broadband noise contributed by earlier stages of the receiver, but at the same time is wide enough not to restrict the receiver's bandwidth. Potentiometer R7 between the first and second amplifiers adjusts the maximum gain of the amplifiers and hence of the whole receiver.

Transistor Q3 serves as a buffer between the 455 kHz amplifier and its three outputs. For signals fed to the FM/CW/SSB Detector (pin 13), Q3 acts as an emitter-follower stage. For the rear panel IF Output, Q3 feeds the signal to Q4, which acts as a power amplifier. Transformer T1 supplies a 50 Ω IF output to the rear panel, providing a nominal 20 mV IF output for RF inputs greater than 3 μV. For the AM detector, Q3 and Q5 both act as common-emitter amplifiers to raise the IF signal to a level of several volts which will permit the detector diode, CR3, to perform linearly. Diodes CR4 and CR5 provide a dc-bias to operate the AM Detector and emitter-follower (Q6) above ground to establish the proper dc level for the AGC circuit. The low-pass filter of L7 and C28 suppresses any residual IF signal.

3.2.11 TYPE 78112 AGC (A4A6)

The primary function of the AGC module is to generate control voltages which adjust the amplification of signals passing through the receiver. When the Fast AGC or Slow AGC gain mode is selected, this module attempts to adjust the receiver's amplification (gain) to maintain a constant output from the AM Detector. If the desired signal entering the receiver should fade in amplitude, the receiver gain would increase just enough to compensate for the fade. When the Manual gain mode is selected, the receiver's gain is fixed at a level which depends on the setting of the RF Gain potentiometer on the front panel. This module, as a secondary function, provides voltage to operate the signal strength meter.

The differences in decay times of Fast AGC and Slow AGC make them useful for different kinds of signals. In the Fast AGC mode, the gain of the receiver adjusts about as quickly for a rise in signal strength as it does for a fall in signal strength. The time taken to respond to a rise is referred to as attack time, and the time taken for a fall is known as decay time. The response to rising signals remains fast in the Slow AGC mode, but when the signal strength falls the change in gain occurs much more slowly. For AM and FM signals, the total power contained in the carrier and sidebands does not vary much with time at the transmitter. With these types of signals, the main purpose of the AGC is to compensate for atmospheric losses between transmitter and receiver. These changes may occur very slowly or as rapidly as several rises and falls per second. For signals of this sort, the characteristics of the Fast AGC mode will usually serve best. However, for pulsed signals such as telegraphy (A1 emission) and for SSB voice signals (A3J emission) there are rapid fluctuations in transmitted power with recurring peaks. When this type of signal is received, it is usually desirable that the AGC have a sort of memory for the peaks but still be able to respond quickly if there is an abrupt increase in signal level. Hence, the fast attack and slow decay times of the Slow AGC will usually be desired for these cases.

There will also be instances where it is desirable to fix the gain of the receiver at some value to make critical comparisons of signal strength or to eliminate signals or noise below a particular amplitude. For these cases, the Manual gain mode is useful. When using this mode, it is desirable to adjust the RF GAIN control so that the signal strength meter reads at the MAN SET line for the average signal to be monitored, to obtain the greatest latitude for signal level change.

In the following discussions, it may be helpful to consider the simplified AGC circuit Figure 3-3 and the schematic Figure 6-8. In the AGC module, the direct coupled output of the AM detector is filtered by R5 and C3 to limit the speed of response of the Fast AGC. In the Fast AGC Mode, Q7 is biased off, disconnecting C4, so Q1 operates simply as an emitter follower. Q7 is biased on when Slow AGC is selected, grounding the negative end of C4. In this case Q1 can charge C4 quickly if there is a rise in input from the AM Detector, but when the input falls below its peak value Q1 is turned off by the charge stored in C4. Q1 continues to be off until C4 is discharged by R3. This action gives the fast attack response and slow decay response of the Slow AGC mode. Zener diode CR2 acts as a limiter to prevent short bursts of signal from overcharging C4 (which might cut off the amplifiers for many seconds).

OP AMP U1A acts as a buffer between C4 and the following circuits. A general-purpose diversity AGC output is provided at pin 16. Transistor Q2 acts as a threshold detector, blocking AGC action for weak signals. This is desirable to allow a maximum signal-to-noise ratio to be obtained in all stages of the receiver before any gain reduction is permitted. The base of Q2 is biased to approximately +0.2 V. If the emitter of Q2 is lower than about +0.8 V, Q2 will be turned off and no AGC action can occur. When the output of U1A is greater than +0.8 V, Q2 conducts and a gain control voltage appears across R13. When the Manual gain mode is selected, Q3 and Q6 will be turned on and will clamp the voltage on R13 to ground, and +5 V will be applied to the RF Gain potentiometer on the front panel. OP AMP U2B acts as an inverting summing amplifier for the voltage at R13 (which will be zero in Manual gain mode) and the voltage on the RF GAIN control (which will be zero in FAST or SLOW AGC modes).

The output of summing amplifier U2B is buffered by OP AMP U1D and fed to the 455 kHz amplifier on A4A7. Zero volts from U1D allows the 455 kHz amplifier to operate at maximum gain while a negative output from U1D causes the gain of the IF amp to be reduced.

A sample of the IF gain control voltage from U2B is also applied to RF AGC threshold detector Q5. This threshold detector causes the gain reduction to occur only in the

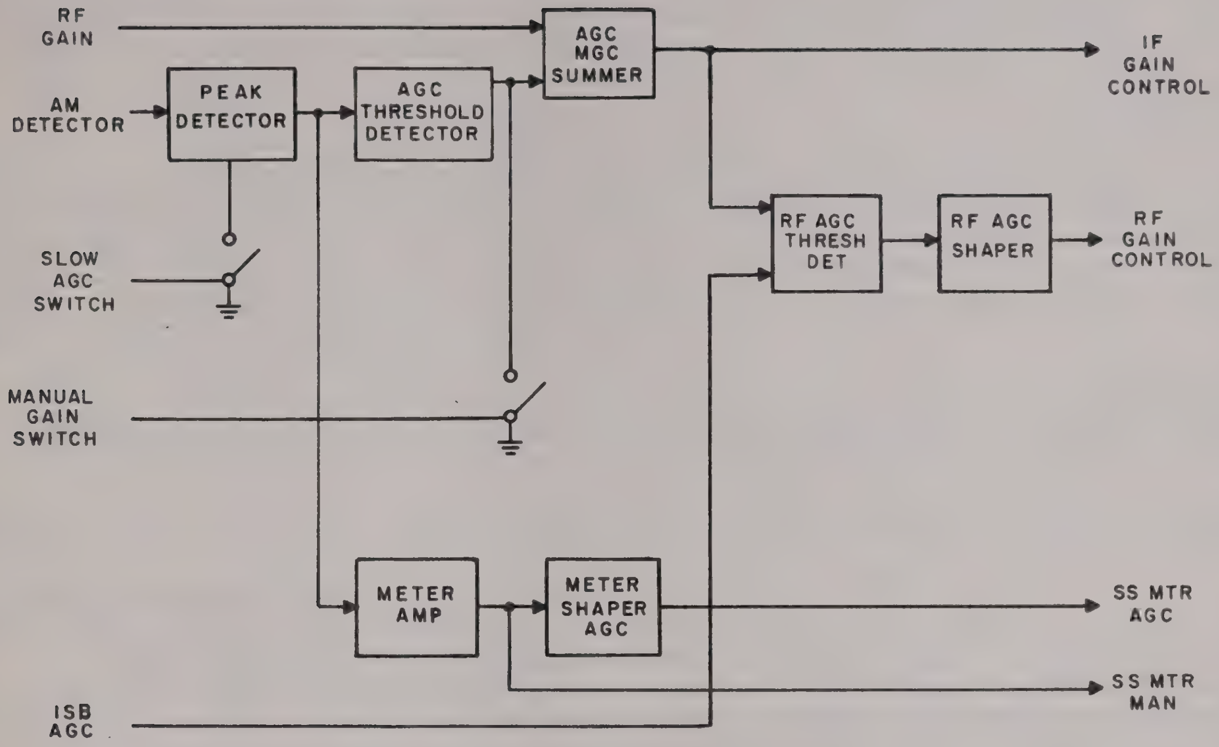


Figure 3-3. Simplified AGC Circuit

3rd IF amplifier, unless the signal at the RF input of the receiver and in the early stages of the receiver is great enough to ensure a good signal-to-noise ratio even in the early stages. The operation of the threshold detector is the same as that of Q2, except with polarities reversed to allow for the inversion which occurs in U2B. The base of Q5 is biased around -2.7 V so the IF gain control voltage must be more negative than -3.3 V for Q5 to conduct. When the ISB Detector and Audio module (A4A8) is installed and energized (ISB mode only), a similar AGC circuit in that module supplies a corresponding sample of its IF gain control voltage to Q4. This allows the RF gain control to respond to either the USB component, amplified by A4A7, or the LSB component, amplified by A4A8. This combined action is necessary to protect against possible overload of the 1st and 2nd IF's which are common to both USB and LSB. Q4 duplicates the operation of Q5. When the ISB module is not installed or not selected, Q4 does not conduct and may be ignored.

As stated in the description of the Input Converter, the gain control in the 1st IF amplifier is accomplished by varying the RF impedance of a diode that shunts the load circuit of one stage. The impedance of this diode is approximately inversely proportional to the dc current through it. Therefore, to obtain a 6 dB gain reduction requires a certain current, an additional 6 dB reduction requires doubling the current and another 6 dB reduction requires four times the original current and so on. To achieve the desired relationship between AM Detector output and RF gain reduction requires that the control diode current rise slowly at first, then more rapidly as the received signal strength increases further (exponentially). This current/voltage relationship is obtained through a shaping network comprised of U2D, R27, R28, CR5, and R31. The actual current for the control diode is supplied by buffer U2A.

The relationship between signal strength and the voltage out of U1A make this voltage suitable for operation of the signal strength meter. In the Manual gain mode, this voltage is proportional to the RF input signal voltage. Its polarity is inverted by OP AMP U1C and it is applied through R49 and front panel switches A10A1S1B and S2C to the meter. This allows the receiver to act as a tuned voltmeter whose calibration depends on the setting of the RF GAIN control.

In the AGC modes, the voltage out of U1A increases approximately linearly with signal voltage up to the AGC threshold level of 3 μV (RF input). Above this level the U1A output is compressed by AGC action to be nearly proportional to the logarithm of the RF input voltage. By using a shaping network composed of R41, R50, R51, CR6, CR7, and CR8 to suitably compress the output of U1C at low signal levels, the signal strength meter is made to be approximately linear in dB over a greater than 100 dB range. Resistors R50 and R51 control the amount of compression and the exact fit of the meter scale with signal strength. If an accurate source of variable signal level is available, these fixed resistors may be replaced with variable ones which may be adjusted for best tracking of the meter. The variable resistors may then be removed, measured and replaced with fixed resistors of the same value.

3.2.12 TYPE 791599 FM/CW/SSB DETECTOR (A4A9)

For FM reception, this module contains a limiter and discriminator. Power for these circuits is supplied when the FM detection mode is selected. For CW or SSB reception, there is a product detector which has its power applied when the CW, USB, LSB, or ISB detection modes are selected. Also, when the product detector is energized, the BFO Synthesizer is enabled and its output is applied to the product detector. The schematic diagram for the following circuit discussion is Figure 6-11.

The IF output sample of approximately 10 mV from the 455 kHz amplifier of A4A7 is the input signal for this module. It is applied to both demodulators although only one is actuated at a time. When FM is selected, the control input at pin 41 is high (+5 V) and Q2 and Q1 are turned on. This applies approximately +9 V to limiter U1. The input signal is amplified and clipped by cascaded stages within U1, so its output is free of any amplitude variations. The extent to which the amplitude variations are removed contributes to the AM rejection of the receiver when receiving FM. The output of the limiter drives the Foster-Seeley discriminator. Diodes CR1 and CR2 rectify the composite signals fed to them by C7 and T1. When the signal from the limiter is at exactly 455 kHz, T1 is tuned so that equal and opposite voltages are produced across load resistors R6 and R7, giving a net output of zero to buffer U3A. For inputs slightly off 455 kHz, the voltages of R6 and R7 do not cancel causing a positive output for inputs above 455 kHz and a negative for those below 455 kHz. (Note that these polarities are reversed by U3C, so the output of the module will go negative when the signal frequency increases.) Proper adjustment of L1 will make the output voltage vary linearly with input frequency over ±8 kHz from 455 kHz. At the output of U3A, a low-pass filter, L3 and C11, reduces higher frequency noise components which are present in the discriminator output.

When the CW mode or any of the sideband modes is selected, the control input on pin 43 is high (+5 V). This turns on Q4 and Q3, applying +9 V to balanced modulator U2. The BFO is also applied to U2 (approximately a 40 mV level). This allows U2 to act as the 4th mixer in the signal path as described in the Synthesizer Relationships section. Its action may be considered to down-convert IF signals to the audio frequency range. For sideband signals, proper tuning of the receiver places the center of the IF signal at the frequency corresponding to the carrier frequency of the received signal. This causes the audio components out of U2 to reconstruct those of the original signal transmitted. For CW signals, the BFO is offset from the signal either by use of the BFO offset control on the front panel or by shifting the tuned frequency slightly. Either method will cause an audible tone at the audio output when a signal is present. When the narrowest IF bandwidth is used, however, the receiver tuning may only be offset a small amount without forcing the signal out of the passband, so the BFO offset must be used to produce a tone in the middle of the audio range where hearing is most acute.

The output of U2 goes through low-pass filter L2 and C17, which reject higher frequency noise components, to buffer U3B. OP AMP U3C acts as a summing amplifier for the outputs of the FM discriminator or product detector when either is present. It gives different amplifications to these two signals to bring them up to approximately equal levels. The audio output of this module goes to both the Audio Amplifier and the FM Audio terminal of TB2 on the rear of the receiver.

3.2.13 TYPE 7459 AUDIO AMPLIFIER (A4A10)

The Audio Amplifier combines the audio outputs of the AM detector and FM/CW/SSB Detector and feeds them to the LINE AUDIO LEVEL control on the rear panel and the PHONE LEVEL control on the front panel. The signal returned from the wiper of the LINE AUDIO LEVEL potentiometer drives the line audio amplifier. The signal returned from the PHONE LEVEL control drives the auxiliary phone amplifier which feeds the PHONE AUDIO terminals on TB1. A rectifier which samples the output of the line audio amplifiers supplies dc to operate the front panel meter in the LINE AUDIO setting.

When the AM detection mode is selected, the control input to pin 47 is high (+5 V). The output of U1A is roughly +14 V, which reverse biases CR1. The gate of FET Q1 will then assume the same potential as its source and Q1 will be on, acting as a closed switch for AM audio. Both demodulators of the FM/CW/SSB Detector will be off so the output of U1D will be AM audio only. When any other detection mode is selected, the control input to pin 47 will be low (0 V) and the output of U1A will be approximately -14 V. This will tend to forward bias CR1 and will cause gate of Q1 to be similarly negative, cutting off all signal flow through Q1. The audio signal from the FM/CW/SSB Detector will appear at the output of U1D.

The signal into line audio amplifier U2 is the output of U1D attenuated by the LINE AUDIO LEVEL control, R1, on the rear panel. The two sections of U2 act as a push-pull bridge amplifier, driving output transformer T2 located on the inside of the rear panel. To permit maximum power output, the amplifier uses the full voltage of the positive power supply rectifier which will be approximately +22 V at normal line voltage. The power supply to U2 is separately filtered by the circuit of Q2, CR4, R28, and C20. A circuit within U2 provides a bias voltage at pin 1 which is equal to one-half the supply voltage. This is connected to the non-inverting inputs of both amplifier sections of U2. Both amplifiers use unity feedback at dc, that is, the only dc path to the inverting inputs is from the outputs, so there is very little dc difference between their outputs at pins 2 and 13.

The input signal is applied to the non-inverting input of U2B, pin 9. Although pins 6 and 9 are at the same dc potential, pin 6 is bypassed so no ac signal appears there. The operation of amplifier U2B will be clear if pin 7, the inverting input of U2A, is considered to be at ac ground. With this assumption, U2B simply appears as a non-inverting amplifier with a closed-loop ac gain of 50. Its ac gain is determined by the ratio of feedback resistors R20 and R19. On the other hand, U2A may then be viewed as an inverting amplifier with an ac gain of nearly one. Its input is the full output of U2B and its gain is determined by R20 and R19 acting as input resistors and R21 as feedback resistor. As with inverting OP AMPs, extremely little signal voltage appears at the amplifier inverting input terminal, thus satisfying the assumption made to explain the behavior of U2B. The net gain of the combined amplifier is 100 and its outputs are balanced with respect to ground. Due to the high current U2 can pass, it is grounded separately from the other circuits on the Audio Amplifier module to prevent ground current coupling which might lead to instability and parasitic oscillations.

The output signal of U2A is rectified and filtered to indicate LINE AUDIO level on the front panel meter. The rectifier is a voltage doubler consisting of CR2, CR3, C12, and C13. It responds to peak-to-peak input voltage and is calibrated by resistors R22, R23, and R24 to indicate the RMS value of a sine-wave at the LINE AUDIO terminals of TB1 on the rear panel. Its calibration is therefore most accurate for sine-wave voltages.

The auxiliary phone amplifier U1B and U1C is a low power bridge amplifier and is therefore similar to U2. It operates from both +15 V and -15 V supplies and has its inputs biased at ground. Comparing its circuit with that of U2 it should be apparent that it also uses unity dc feedback and has a closed loop gain of 100 for ac signals. Its output current capability is much lower than U2, so it can only supply slightly over 100 mW compared to over 2 Watts from U2.

If it should be desired to control the Line Audio level from the front panel, it is possible with a simple modification to the IF Motherboard. If the lead from J1 pin 14 at the rear end of the IF Motherboard to XA10 pin 17 is disconnected, and XA10 pin 17 is connected to XA10 pin 19, the LINE AUDIO level will be controlled by the PHONE LEVEL control on the front panel. In some receivers this will require cutting the printed circuit track from J1 to XA10. If this must be done, use a sharp knife and some care to see that a small gap is made all the way through the copper track.

3.2.14 TYPE 791598 ISB DETECTOR/AUDIO OPTION (A4A8)

The schematic diagram for this circuit description is Figure 6-10. For ISB operation, two independent single sideband signals must be demodulated. Since they share the same carrier frequency, they may be processed together up to a certain point. In this receiver, ISB is handled as a single composite signal through the 3rd Mixer. At that point it is split, the USB component being filtered and passed through the main signal path, the LSB component filtered and separately amplified and demodulated by the ISB Detector and Audio module.

The ISB Detector and Audio module is therefore a combination of circuits from other modules previously discussed. There is a 455 kHz amplifier similar to part of A4A7, a product detector similar to that on A4A9, an AGC circuit like part of A4A6, and an ISB line audio amplifier similar to the auxiliary phone amplifier on A4A10. A sample of the AGC voltage developed in this module is sent to the main AGC module to produce a combined RF AGC. If this module is not installed in the receiver, operation in any mode except ISB will not be affected.

Common source FET amplifiers Q1 and Q2 have variable gain depending on their gate 2 voltage. This voltage is derived from the module's AGC section. Potentiometer R8 is used to set the maximum gain of the amplifier to give the same input level to balanced modulator U1 as is received by A4A9U2 at low signal levels. To adjust maximum gain, tune to an AM signal of about a 1 µV level and set R8 so that equal USB and LSB outputs appear at the front panel PHONES jack.

Balanced modulator U1 uses the BFO to act as a 4th Mixer and converts the LSB signal to audio. When the ISB mode is selected, +5 V is applied to pin 49 and U2A switches on, supplying power to U1. Its output is low-pass filtered and then amplified by U3A. The output

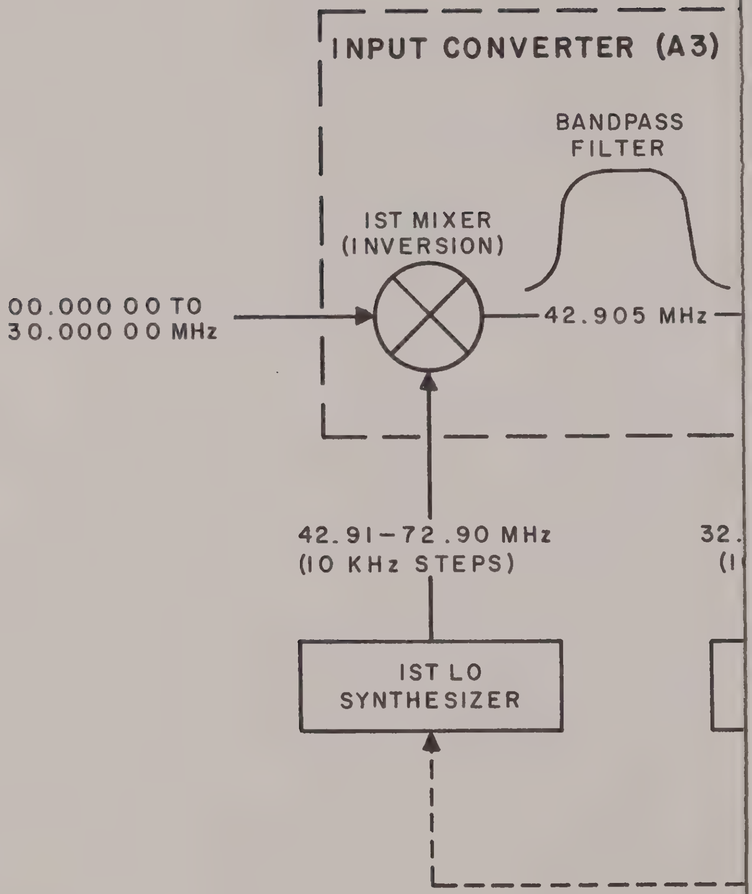


Figure 3-4. Frequency Synthesizers Functional Re

of U3A splits three ways. It leaves the module to go to the front panel which provides LSB phone audio in the ISB mode. It also feeds the ISB Line Audio amplifier through level control R36, and drives the AGC circuit.

The AGC is a simplified form of the one on A4A6. It always acts in the Slow AGC mode. Peak detector Q4 charges C19, which discharges through R52. Buffer U2D drives AGC threshold detector Q3. The output of Q3 is amplified by U3D to supply the IF AGC to amplifiers Q1 and Q2 via buffer U3C, and the sample to the RF AGC circuit on A4A6. When the ISB mode is selected, Q5 is turned off by the positive output from U2A. No meter outputs are supplied by this module.

The ISB Line Audio amplifier (U2B and U2C) is identical, except for component values, to the auxiliary phone amplifier on A4A10.

3.3 SYNTHESIZER SECTION

3.3.1 SYNTHESIZER RELATIONSHIPS

Figure 3-4 shows the relationship of the synthesizers to the receiver signal processing. Together, three synthesizers translate all RF input signals to 455 kHz. Other stages of the receiver then demodulate this 455 kHz IF. If the receiver operates in the CW or a sideband mode, a fourth synthesizer signal beats with the 455 kHz IF to produce an audio output. The tuning process involves the 1st and 2nd LO; the 3rd LO is fixed at 11.155 MHz and the BFO varies ±8.9 kHz from 455 kHz.

The 1st LO tunes from 42.91 MHz to 72.90 MHz, in 10 kHz steps. This range corresponds to an RF input range of 00.00000 MHz to 29.99999 MHz. Each 10 kHz step of the 1st LO causes a different 10 kHz section of the RF spectrum to be converted to the center of the 1st IF range (42.90 MHz to 42.91 MHz) by taking the difference products from the 1st Mixer. A filter follows the 1st mixer which passes signals in this 10 kHz range, plus their sidebands which extend approximately 9 kHz beyond each end of this range, for a total bandwidth of 28 kHz.

The 2nd LO tunes from 32.21000 MHz to 32.20001 MHz, in 10 Hz steps. This range allows conversion of any signal in the 1st IF range to the center frequency of the 2nd IF (10.7 MHz), by the 2nd Mixer. A 16 kHz bandpass filter follows the 2nd Mixer to set the receiver's maximum IF bandwidth. As the receiver is tuned upward, the 2nd LO tunes downward across its entire range, then returns to its starting frequency as the 1st LO steps up to its next increment. This interlocking sweep action allows any 10 Hz increment of the RF range to be converted to the center of the 10.7 MHz 2nd IF passband.

The 3rd LO provides an 11.15500 MHz signal to the 3rd Mixer. Signals centered on 10.7 MHz output from the 2nd Mixer mix with the signal from the 3rd LO to produce signals centered at 455 kHz. The output from the 3rd Mixer passes through another bandpass filter either to be demodulated by other stages in the receiver or mixed with the BFO output for CW or Sideband detection.

The BFO Synthesizer produces a signal ranging from 446.1 kHz to 463.9 kHz. This range centers about 455 kHz (±8.9 kHz) and beats with the 455 kHz signal from the 3rd Mixer to produce an audio output.

All four synthesizer circuits are synchronized by a common Time Base. Reference frequencies of 1 MHz, 50 kHz, 40 kHz, 10 kHz, and 1 kHz are supplied from a 2 MHz temperature compensated crystal oscillator (TCXO).

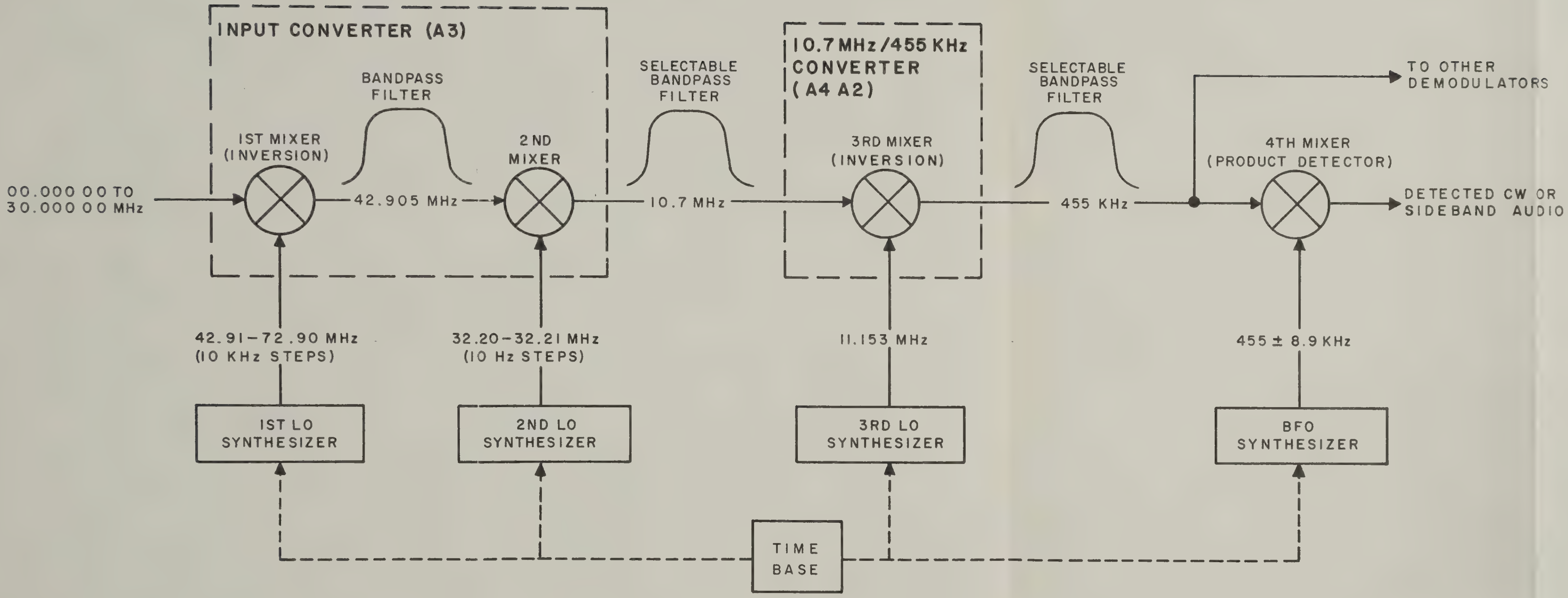


Figure 3-4. Frequency Synthesizers Functional Relationship

of U3A splits three ways. It leaves the module to go to the front panel which provides LSB phone audio in the ISB mode. It also feeds the ISB Line Audio amplifier through level control R36, and drives the AGC circuit.

The AGC is a simplified form of the one on A4A6. It always acts in the Slow AGC mode. Peak detector Q4 charges C19, which discharges through R52. Buffer U2D drives AGC threshold detector Q3. The output of Q3 is amplified by U3D to supply the IF AGC to amplifiers Q1 and Q2 via buffer U3C, and the sample to the RF AGC circuit on A4A6. When the ISB mode is selected, Q5 is turned off by the positive output from U2A. No meter outputs are supplied by this module.

The ISB Line Audio amplifier (U2B and U2C) is identical, except for component values, to the auxiliary phone amplifier on A4A10.

3.3 SYNTHESIZER SECTION

3.3.1 SYNTHESIZER RELATIONSHIPS

Figure 3-4 shows the relationship of the synthesizers to the receiver signal processing. Together, three synthesizers translate all RF input signals to 455 kHz. Other stages of the receiver then demodulate this 455 kHz IF. If the receiver operates in the CW or a sideband mode, a fourth synthesizer signal beats with the 455 kHz IF to produce an audio output. The tuning process involves the 1st and 2nd LO; the 3rd LO is fixed at 11.155 MHz and the BFO varies ±8.9 kHz from 455 kHz.

The 1st LO tunes from 42.91 MHz to 72.90 MHz, in 10 kHz steps. This range corresponds to an RF input range of 00.00000 MHz to 29.99999 MHz. Each 10 kHz step of the 1st LO causes a different 10 kHz section of the RF spectrum to be converted to the center of the 1st IF range (42.90 MHz to 42.91 MHz) by taking the difference products from the 1st Mixer. A filter follows the 1st mixer which passes signals in this 10 kHz range, plus their sidebands which extend approximately 9 kHz beyond each end of this range, for a total bandwidth of 28 kHz.

The 2nd LO tunes from 32.21000 MHz to 32.20001 MHz, in 10 Hz steps. This range allows conversion of any signal in the 1st IF range to the center frequency of the 2nd IF (10.7 MHz), by the 2nd Mixer. A 16 kHz bandpass filter follows the 2nd Mixer to set the receiver's maximum IF bandwidth. As the receiver is tuned upward, the 2nd LO tunes downward across its entire range, then returns to its starting frequency as the 1st LO steps up to its next increment. This interlocking sweep action allows any 10 Hz increment of the RF range to be converted to the center of the 10.7 MHz 2nd IF passband.

The 3rd LO provides an 11.15500 MHz signal to the 3rd Mixer. Signals centered on 10.7 MHz output from the 2nd Mixer mix with the signal from the 3rd LO to produce signals centered at 455 kHz. The output from the 3rd Mixer passes through another bandpass filter either to be demodulated by other stages in the receiver or mixed with the BFO output for CW or Sideband detection.

The BFO Synthesizer produces a signal ranging from 446.1 kHz to 463.9 kHz. This range centers about 455 kHz (±8.9 kHz) and beats with the 455 kHz signal from the 3rd Mixer to produce an audio output.

All four synthesizer circuits are synchronized by a common Time Base. Reference frequencies of 1 MHz, 50 kHz, 40 kHz, 10 kHz, and 1 kHz are supplied from a 2 MHz temperature compensated crystal oscillator (TCXO).

Table 3-3 provides an example of frequency translation from the RF input to the output of the 3rd Mixer. This translation begins with an RF input signal of 00.00000 MHz (column A) and ends with a signal centered at 455 kHz. Columns B and C are tabulated for input frequencies of 00.00500 and 00.01999 MHz, respectively. In column C, notice that the 1st LO has stepped up to its second increment (42.92 MHz).

Table 3-3. 1st and 2nd LO Tuning Increments

	RF INPUT	A (0.00000 MHz)	B (0.00500 MHz)	C (0.01999 MHz)
1st MIXER	1st LO	42.91000	42.91000	42.92000
	RF INPUT	-00.00000	-00.00500	-00.01999
	1st IF	42.91000	42.90500	42.90001
2nd MIXER	1st IF	42.91000	42.90500	42.90001
	2nd LO	-32.21000	-32.20500	-32.20001
	2nd IF	10.70000	10.70000	10.70000
3rd MIXER	3rd LO		11.15500	
	2nd IF		-10.70000	
	3rd IF		0.45500	
4th MIXER	3rd IF		0.455	AM or FM DEMODULATOR
	BFO		-0.455 ±8.9 kHz	
	AUDIO		±8.9 kHz	

The 2nd Mixer translates the signals in the 1st IF range to the 2nd IF frequency of 10.7 MHz. The 9.99 kHz range of the 2nd LO works with the increment sizes of the 1st LO to provide a translation of all 1st IF signals to 10.7 MHz. The corresponding 2nd LO frequencies are shown in Table 3-3 along with the resultant 2nd IF of 10.7 MHz. To determine the 1st LO and 2nd LO frequencies corresponding to a received RF frequency, refer to the examples in Table 3-4.

The 3rd Mixer converts the 10.7 MHz 2nd IF to 455 kHz. A fixed 3rd LO frequency of 11.15500 MHz provides the necessary difference frequency for this conversion. The 3rd IF resultant is shown only in column B. Demodulation of the 3rd IF takes place either in the 4th Mixer (product detector) or in the AM or FM demodulation stages of the receiver.

In CW detection mode, the product detector combines the 455 kHz signal from the 3rd Mixer with the 455 ±8.9 kHz variable BFO signal. The resultant signal is an audible tone for monitoring. For single sideband demodulation, the BFO signal is fixed at 455 kHz, and is mixed with the filtered 3rd IF sideband to produce an audio signal.

3.3.2 PHASE LOCK LOOPS

3.3.2.1 General

The phase lock loop is the method used in this receiver to provide accurate numerical control of the local oscillator frequencies. This technique allows the oscillators to be controlled by any appropriate source of BCD digital data, including remote control sources.

Table 3-4. 1st and 2nd LO Frequencies Versus Tuned Frequency

To Obtain 1st and 2nd LO Frequencies for Any Tuned Frequency
Example Frequency 15.75635 MHz

TO OBTAIN 1st LO FREQUENCY Use 4 Most Significant Digits From Readout	TO OBTAIN 2nd LO FREQUENCY Use 3 Least Significant Digits From Readout
15.75000	00.00635
Add 42.91 to these Digits	Subtract them from 32.21000
Add 15.75 42.91 58.66 = Frequency 1st LO	Subtract 32.21000 .00635 32.20365 = Frequency 2nd LO

The basic phase lock loop is composed of four circuits: a phase detector, a low-pass filter (sometimes called a lead-lag filter, integrator, or loop filter), a voltage-controlled oscillator (VCO), and a frequency divider (counter). A basic phase lock loop configuration is shown in Figure 3-5. Depending on the application, the frequency divider circuit may be fixed (to divide by a certain number), or may be programmable to divide by any number in a specific range (20 to 29, for example). The frequency divider may consist of several counters cascaded together, to provide division by a large number. The operation of the basic phase lock loop requires a stable fixed frequency source, to be used as the reference frequency. This receiver contains a temperature-compensated crystal oscillator (TCXO) to provide the basic reference frequency, and may also be operated using an externally supplied 1 MHz reference signal. Both fixed and programmable loops are discussed in the following paragraphs.

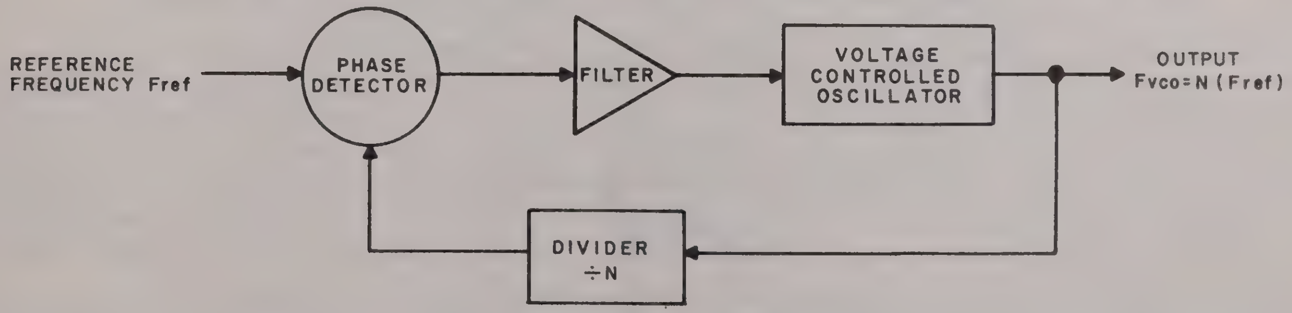


Figure 3-5. Basic Phase Lock Loop Configuration

3.3.2.2 Basic Phase Lock Loop

The basic phase lock loop technique compares the frequency and phase of an incoming reference signal to the output of the voltage controlled oscillator (VCO). If the two signals differ in frequency and/or phase, an error voltage is generated by the phase detector/filter and applied to the VCO, causing it to correct in the direction required for decreasing the frequency/phase difference. The phase detector produces output pulses which are related to the frequency/phase difference. The filter circuit averages (integrates) these pulses into a proportional error correction voltage. This voltage is applied to control the capacitance of a varicap diode in the VCO circuit, and thus tune the VCO toward the correct frequency. The correction procedure continues until lock is achieved, after which the VCO will track the incoming reference signal.

Dividing a VCO output by two before applying it to the phase detector results in an error voltage that drives the VCO to twice the reference frequency. A divide-by-3 action results in an error voltage that drives the VCO to three times the reference frequency. Thus, the reference frequency is always multiplied by the divider ratio to give the VCO output frequency. From this, the following relationship can be given:

$$Fvco = N\,(Fref)$$

An example of the basic phase lock loop technique, using numbers, will provide an understanding of its actual operation. Referring to Figure 3-6, the desired frequency is obtained by programming the variable divider through selectable inputs. Assuming the VCO is locked at the desired frequency of 25 MHz, this signal enters the input of the (in this case) divide-by-25 counter (divider). The counter emits a pulse at its output each time 25 pulses enter its input. Therefore, the 25 MHz input results in an output of 1 MHz. This 1 MHz signal is compared to the reference frequency of 1 MHz, indicating a locked situation. If the divider's output had been less than 1 MHz, the phase detector would have produced pulses to drive the VCO to a higher frequency. Similarly, if the divider's output had been greater than 1 MHz, the VCO would have been driven to a lower frequency. An important concept to be noted here is that the phase lock loop's output frequency is dependent upon the selectable inputs of the variable divider.

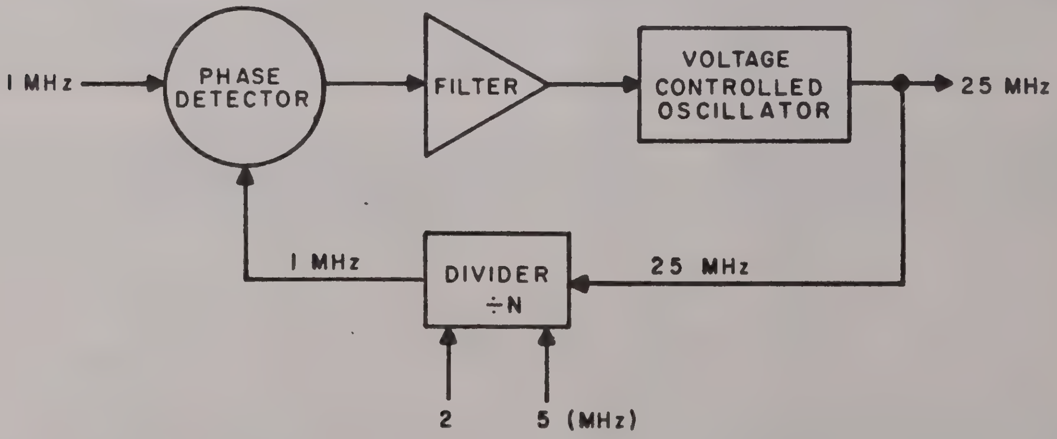


Figure 3-6. Programmable Phase Lock Loop

3.3.2.3 Phase Lock Loop Prescaling Technique

A variation of the basic phase lock loop, shown in Figure 3-7, is utilized in the 1st and 2nd LO Synthesizers. The divider portion consists of a two modulus prescaler and two programmable counters. The two-modulus (divider) prescaler accepts the output from the VCO and divides it by one of two numbers (P or P+1). The prescaler in the 1st LO is a divide-by-50/51 counter and the 2nd LO prescaler is a divide-by-100/101 counter. The swallow counter controls the number of times the prescaler divides by P+1. The programmable counter counts the number of pulses from the prescaler. Totally, these three components provide for coarse (N) and fine (A) tuning of the VCO.

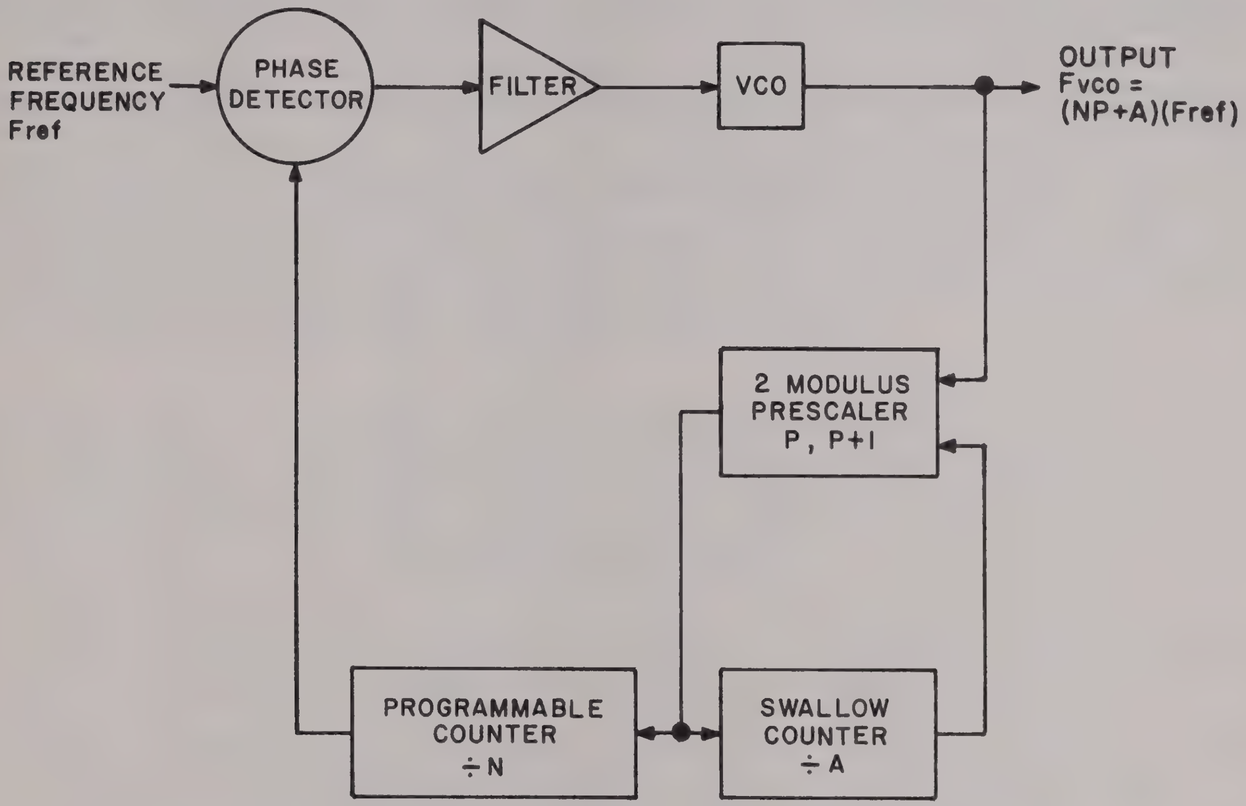


Figure 3-7. Two-Modulus Prescaling in the Phase Lock Loop

In operation, the prescaler divides by P+1, A times. For every P+1 pulse from the prescaler, both the swallow counter and programmable counter are decremented by 1. The prescaler divides by P+1 until the swallow counter reaches its zero state. At this point, the modulus of the prescaler changes to P and the swallow counter is disabled. The prescaler then divides by P until the remaining count in the programmable counter (N-A) decrements to zero. At this time the output of the programmable counter emits a pulse while the swallow and programmable counters are reset. The cycle then repeats.

An example of the two-modulus prescaling technique is given in Figure 3-8. For illustration, a VCO output of 153 MHz is desired. Selected into the programmable counter are the two most significant digits, 1 and 5. Selected into the swallow counter is the least significant digit, 3. Under lock conditions, the divider has an input of 153 MHz and an output of 1 MHz.

To produce a 1 MHz signal from a 153 MHz signal requires a divide ratio of 153. The table in Figure 3-8 shows a count sequence with 153 input pulses resulting in one output pulse. Similarly, a 153 MHz input results in a 1 MHz output. The programmable counter emits a pulse every time it counts 15 pulses. With the swallow counter set to three the prescaler divides-by-11 three times and then switches to the divide-by-10 state. At this point, the programmable counter needs 12 input pulses before emitting an output pulse. The prescaler then divides-by-10 twelve times to finish the count sequence. With 3 counts of 11 (3x11=33), and 12 counts of 10 (12x10=120), one output pulse emits from the programmable counter every 153 input pulses (33+120=153).

The two phase lock loop types described are used throughout the WJ-8718 synthesizer section. The 1st LO and part of the 2nd LO utilize the prescaler configuration while the 3rd LO and another part of the 2nd LO use a fixed divide-by-N ratio. The BFO uses the basic phase lock loop configuration, utilizing the divide-by-N technique (Fvco=N Fref). Common to all the synthesizers in this receiver is the phase detector used. It will be described in detail below.

PROGRAM COUNTER	SWALLOW COUNTER	PRESCALER COUNTS	INPUT PULSES
15	3	0	0
14	2	11	11
13	1	11	22
12	0	11	33
11	-	10	43
10	-	10	53
9	-	10	63
8	-	10	73
7	-	10	83
6	-	10	93
5	-	10	103
4	-	10	113
3	-	10	123
2	-	10	133
1	-	10	143
0	-	10	153

153 INPUT PULSES = 1 OUTPUT PULSE

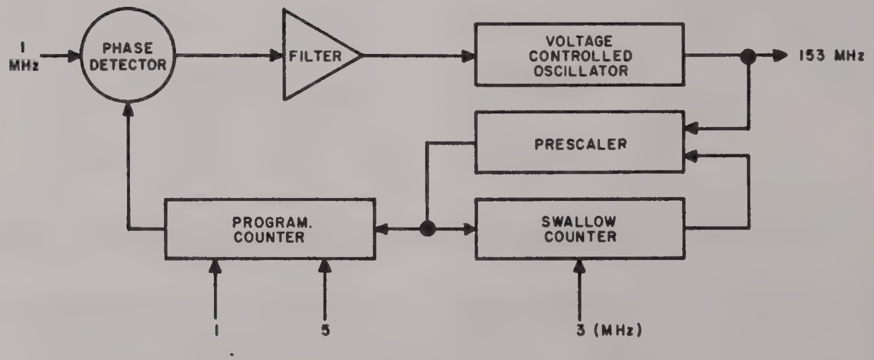


Figure 3-8. Prescaler Dividing Technique

3.3.2.4 Phase Detector

The phase detector used in all of the synthesizers is actually a phase and frequency detector. The integrated circuit also includes a charge pump and an amplifier. Each of these three sections will be discussed below. Table 3-5 provides some information about the phase detectors in these synthesizers. Refer to the 1st and 3rd LO schematic diagram, Figure 6-16, for illustration of typical phase detector operation.

Table 3-5. Receiver's Phase Lock Loop Characteristics

Synthesizer	Phase Detector		Programmable Divider?	VCO Range	Output Frequency
	Ref. Des.	Ref. Freq.			
1st LO	U5	40 kHz	YES	171.64-291.60 MHz	42.91-72.90 MHz
2nd LO 32M	U1A, B	1 MHz	NO	32 MHz	
PROG	U12A, B	10 kHz	YES	200-210 MHz	
OUT	U6A, B	200-210 kHz	NO	32.20-32.21 MHz	32.20-32.21 MHz
3rd LO	U22A, B	5 kHz	NO	11.155 MHz	11.155 MHz
BFO	U9A, B	1 kHz	YES	4461-4639 kHz	446.1-463.9 kHz

The phase detector normally receives a fixed reference frequency at one input (R) and a variable frequency at the input (V) from the divider section. The output responds only to transitions from the two inputs and has four output states as shown in Figure 3-9. If the frequency and phase match exactly, outputs U and D remain high. If the variable input leads in phase with respect to the reference input, U remains high and D goes low. If the variable input lags in phase with respect to the reference input, D remains high and U goes low. When inputs V and R are separated by a frequency difference, the output at pins U or D varies high and low at a rate proportional to the difference frequency of the two inputs.

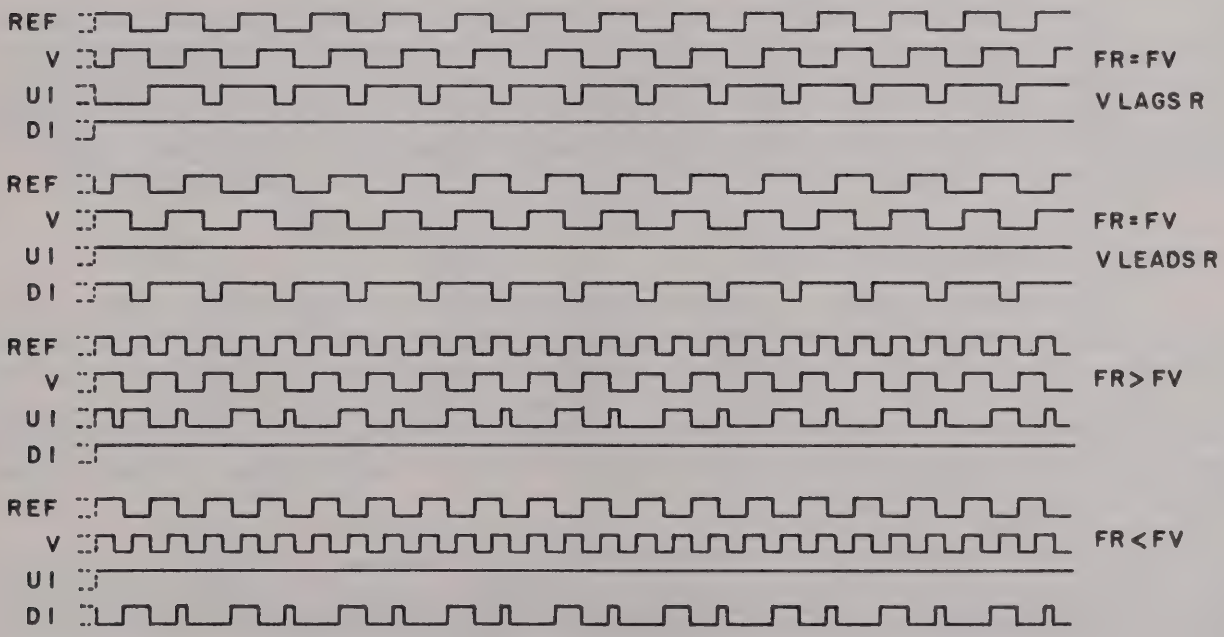


Figure 3-9. Phase Detector Timing Diagram

Under lock conditions, when the input of both V and R are identical in phase and frequency, the output pulses from U and D′ will be extremely narrow and appear on an oscilloscope as spikes. For a large difference between the two input frequencies, as when a new LO frequency is established, the outputs respond as described above with wide pulses appearing on the proper outputs.

The charge pump accepts both outputs from the phase detector and translates the voltage levels before they are applied to the loop filter. The input to pin 11 appears as an inverted output at pin 10. The input to pin 4 appears as an output at pin 5. There will be a pulsed waveform entering either pin 4 or pin 11 at any given time. The charge pump delivers voltage commands from 2.25 V on positive swings to 0.75 V on negative swings, with a mean value of 1.5 V. The charge pump outputs are applied to a low-pass active filter.

The active filter normally uses the amplifier contained in the phase detector IC plus external resistors and capacitors. In some cases an external transistor will also be used, or an external OP AMP. This filter has a direct influence on loop bandwidth, capture range, and transient response. Its output is the VCO tuning voltage, which is applied to control the capacitance of a varicap tuning diode in the VCO tank circuit, thereby controlling the VCO frequency.

3.3.3 TYPE 791600 TIME BASE CIRCUITS (A5A1A2)

The Time Base circuits are part of the Type 791600 board, A5A1A2. The Time Base circuits have two sources of reference from which to choose. A functional description is given along with the functional block diagram shown in Figure 3-10. Reference designations are included in the diagram and correlate with the Time Base portion of the 1st and 3rd LO/Time Base Schematic, Figures 6-15 and 6-16.

3.3.3.1 Functional Description

The Time Base shown in Figure 3-10 can be controlled internally with a 2 MHz temperature compensated crystal oscillator (TCXO) and divide-by-2 frequency divider, or with a 1 MHz external source. This 1 MHz reference is divided down to 50 kHz, 40 kHz, 10 kHz, and 1 kHz. Buffer amplifiers Q6 and Q7 are used for isolation purposes. Synthesizers that need certain reference frequencies are listed below each frequency in the diagram. Refer to the schematic diagram in Figure 6-15. S2 in Figure 3-10 represents the function of U23.

3.3.3.2 Circuit Description

An internal source of reference is provided by a 2 MHz TCXO, while an external source of reference must be a 1 MHz signal of approximately 50 mV. Tri-state buffers accomplish the switching of internal and external reference sources. A truth table of the tri-state buffers used is given in Figure 3-11. Getting information from input A to output Y depends upon the state of input C. Information passes from input A to output Y when the state of input C is low. Similarly, information is inhibited from the output when the state of input C is high.

When operating with an external source of reference, the external select (EXT SEL) line is grounded and the internal select (INT SEL) is pulled high by R84, and the externally supplied 1 MHz reference is seen at module pin A17, EXT/INT STD. The internal 1 MHz reference is inhibited when it reaches tri-state buffer U23B. Therefore, the only source for the 1 MHz signal to transformer T1 is the external one. T1 and C23 resonate at 1 MHz while the voltage divider of R34 and R35 shifts the 1 MHz signal to a 2.5 Vdc level. This signal enters U16 which converts the sine wave to TTL levels. The output of U16 passes through tri-state buffer U23A and on to the rest of the Time Base circuits.

Operation with the internal source grounds the internal select (INT SEL) line and allows the external select line to be pulled up by R85. Tri-state buffer U23 allows the 2 MHz signal that is divided to 1 MHz to be passed on to the rest of the circuitry. The 1 MHz reference splits to two parts of the circuit. In one direction, the reference signal passes through U23C and out the EXT/INT STD connection. The signal does continue to pass through U16 but is inhibited at U23A. In the other direction, the reference signal passes to pin 3 of U23A (EXT) or pin 11 of U23B (INT), and on to the rest of the time base circuitry.

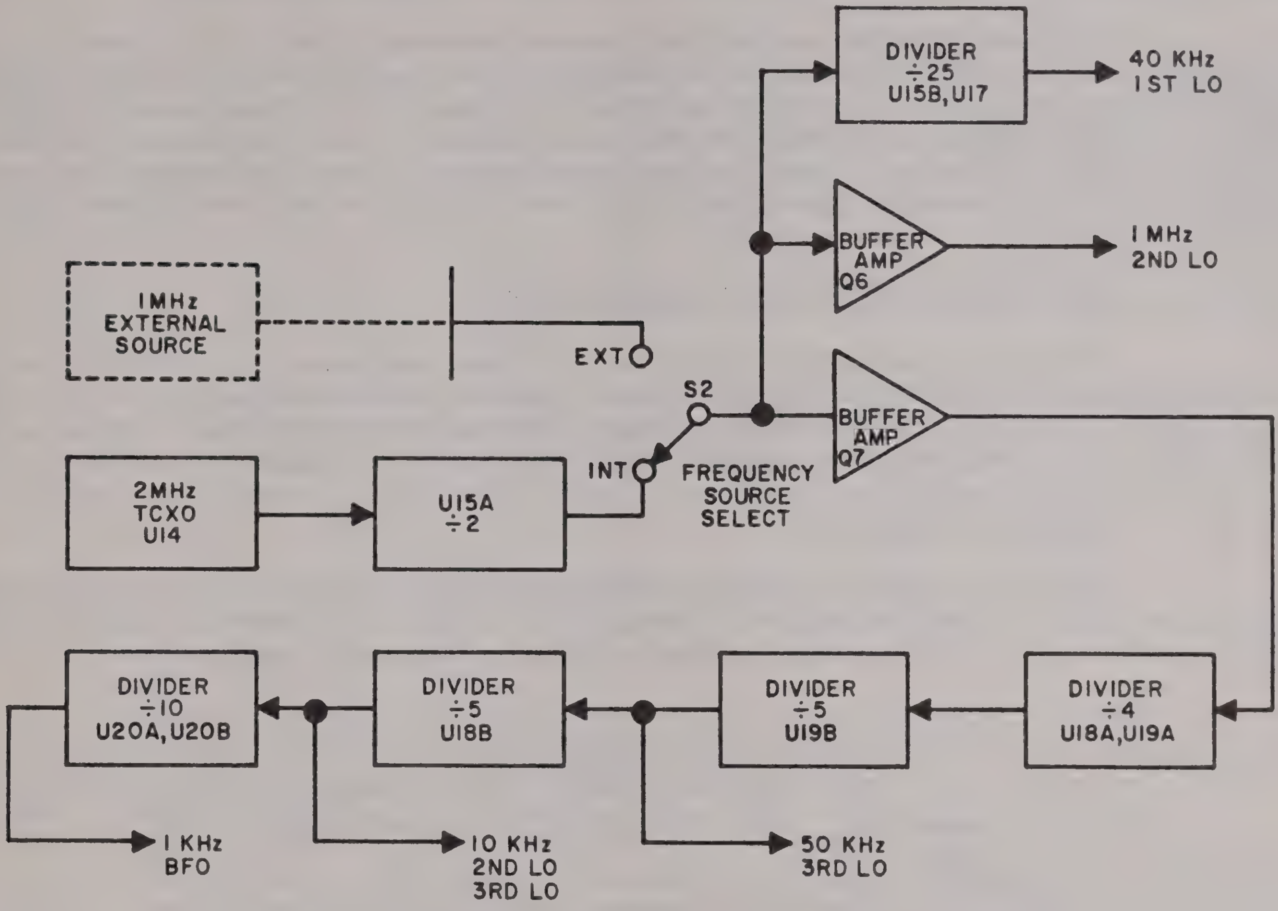
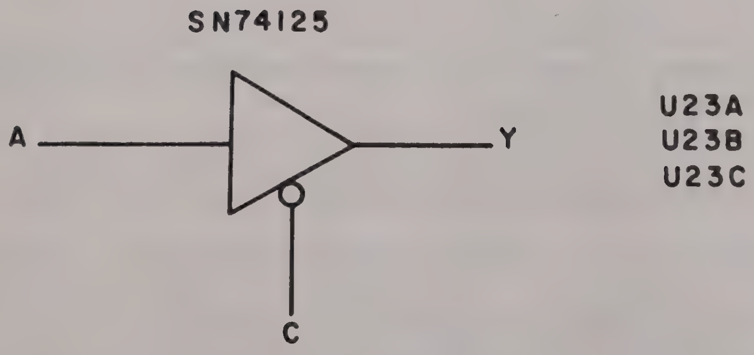


Figure 3-10. Time Base Circuits Functional Block Diagram



TRUTH TABLE

INPUTS		OUTPUTS
A	C	Y
H	L	H
L	L	L
X	H	HI-Z

Figure 3-11. Tri-State Buffers

For either source of reference, a 1 MHz TTL signal is present at the input of Q6 and U15B. This signal is divided by 25, through U15B and U17, to become a 40 kHz reference for the 1st LO. The 1 MHz signal also passes through an isolation amplifier Q6 to board pin A9 to be used as a reference for the 2nd LO. The 1 MHz signal also passes through another isolation amplifier, Q7, to be divided down to three more reference frequencies.

U18A and U19A form a divide-by-4 network whose input is 1 MHz and whose output is 250 kHz. This 250 kHz divides down to 50 kHz through divider U19B and is sent to U21B, the digital mixer of the 3rd LO. The output of U19B also enters U18B, whose output is a 10 kHz signal. This signal leaves the board to be used as a reference for the 2nd LO, and is divided to 5 kHz by U21A to act as a reference for the 3rd LO circuit. The 10 kHz signal also passes through a divide-by-10 network, consisting of U20A and U20B, for an output reference signal of 1 kHz.

3.3.4 TYPE 791600 3RD LO SYNTHESIZER (A5A1A2)

The 3rd LO is part of the 1st and 3rd LO/Time Base board, Type 791600. The 3rd LO has an input of two reference frequencies from the Time Base and a fixed output frequency of 11.155 MHz. The 3rd LO utilizes a basic phase lock loop configuration and a digital mixing technique. A functional description along with a circuit description is provided below.

3.3.4.1 Functional Description

Figure 3-12 shows a functional block diagram of the 3rd LO. Included in the diagram are reference designations that correspond to the 3rd LO schematic. The 3rd LO is part of the 1st and 3rd LO/Time Base schematic diagram, Figures 6-15 and 6-16.

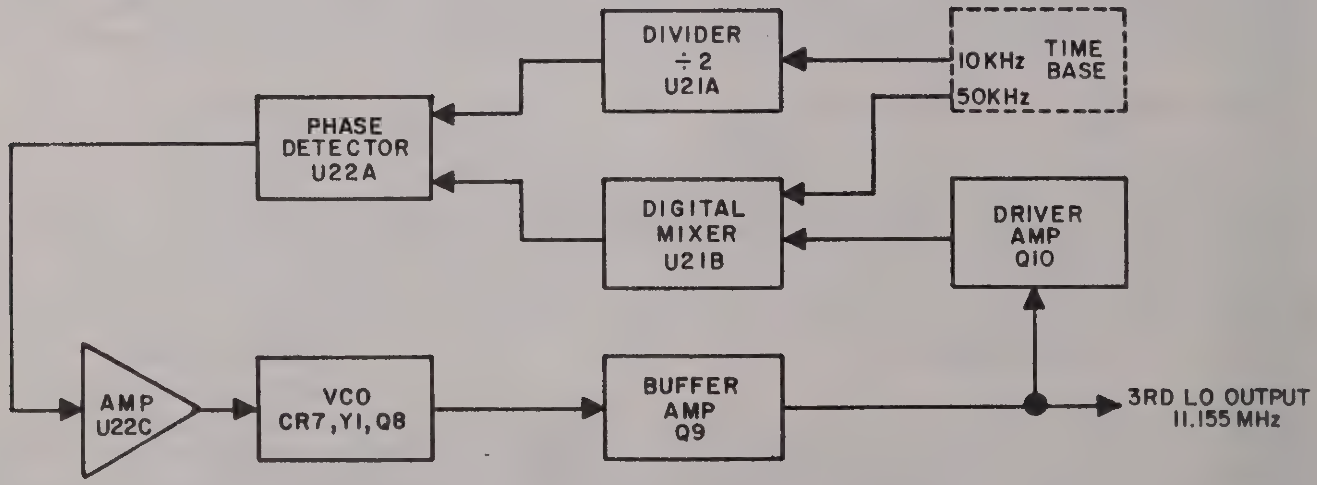


Figure 3-12. 3rd LO Functional Block Diagram

The VCXO (voltage-controlled crystal oscillator) for this synthesizer is formed by Q8, Y1, CR7, and their associated components. The oscillator is crystal-controlled to 11.155 MHz, and will be driven into proper phase relationship by the dc tuning voltage applied to CR7. The oscillator signal is buffered by emitter-follower Q9 and is split into two signal paths. One path is to board pin A55, the 3rd LO output. The other path is to flip-flop U21B. The flip-flop acts as a digital mixer, producing an output frequency equal to the difference between the VCO frequency (11.155 MHz) and the frequency that is the nearest integral multiple of the clock frequency (223 x 50 kHz = 11.15 MHz). The difference equals 5 kHz. This signal is applied to phase detector U22 along with a 5 kHz reference derived from the Time Base circuit by U21A. The error pulses are integrated into a control voltage for the VCO.

3.3.4.2 Circuit Description

The 3rd LO output, found at pin A55 of the 1st and 3rd LO Synthesizer board (A5A1A2), is roughly a 100 mV rms sine wave. This signal also couples to Q10, through C37, where it is amplified to levels applicable for the digital mixer. The 3rd LO signal is compared to a 50 kHz reference at pin 11 of U21B, to produce a 5 kHz output, when the 3rd LO is locked. This 5 kHz signal from the mixer is compared to a 5 kHz signal from the time base, via divide-by-2 U21A, in the phase detector, U22A. The charge pump U22B converts the differences in phase and/or frequency into positive and negative going dc levels. These levels pass through filter U22C and bias varactor diode CR7. The 11.155 MHz crystal oscillator is then driven in the direction to achieve lock. The 3rd LO frequency then passes through buffer amplifier Q9 and TTL driver Q10 to complete the loop.

Although the VCO incorporates a 11.155 MHz crystal, Y1, a phase lock loop is still needed. The purpose of the phase lock loop is to vary the oscillator frequency for the purpose of phase-locking it with the Time Base. With the phase lock loop disconnected, the crystal oscillator can produce a usable output frequency for the 3rd LO but would not be exactly the correct frequency to mix with the 10.7 MHz output of the 2nd Mixer.

3.3.5 TYPE 791576 BFO SYNTHESIZER (A5A3)

3.3.5.1 Functional Description

The BFO Synthesizer produces a 455 kHz ±8.9 kHz signal. The BFO therefore tunes from 446.1 to 463.9 kHz, in 100 Hz steps. This synthesizer utilizes the basic phase lock loop configuration shown in Figure 3-5. The actual phase lock loop operates at a frequency range of 10 times the BFO output to allow for the use of a 1 kHz reference frequency.

A functional block diagram of the BFO Synthesizer is shown in Figure 3-13. Some reference designations are included in the diagram and correlate with the BFO schematic diagram, Figure 6-18. The functional block diagram does not include all external connections and should only be used with this discussion.

The VCO produces a frequency that is distributed to the BFO output connection (via divide-by-10 counter U10) and to the programmable counter clock inputs. The presettable inputs, in conjunction with the end of cycle detector, create a divide-by-N counter. The end of cycle detector produces pulses which are compared to a 1 kHz reference frequency in the phase detector. The resultant output is pulses that characterize the difference in frequency and phase of the two input frequencies. The loop filter takes the output pulses from the phase detector and integrates them into a varying dc voltage. This varying voltage drives the VCO in the proper direction to establish the desired frequency.

3.3.5.2 Circuit Description

The circuit description of the BFO Synthesizer is presented in a sequential manner to facilitate understanding. The BFO phase lock loop will be discussed in the following order: programmable divider, phase detector, charge pump, loop filter, and VCO. Integrated circuit data is supplied where needed. The BFO Synthesizer schematic diagram is shown in Figure 6-18.

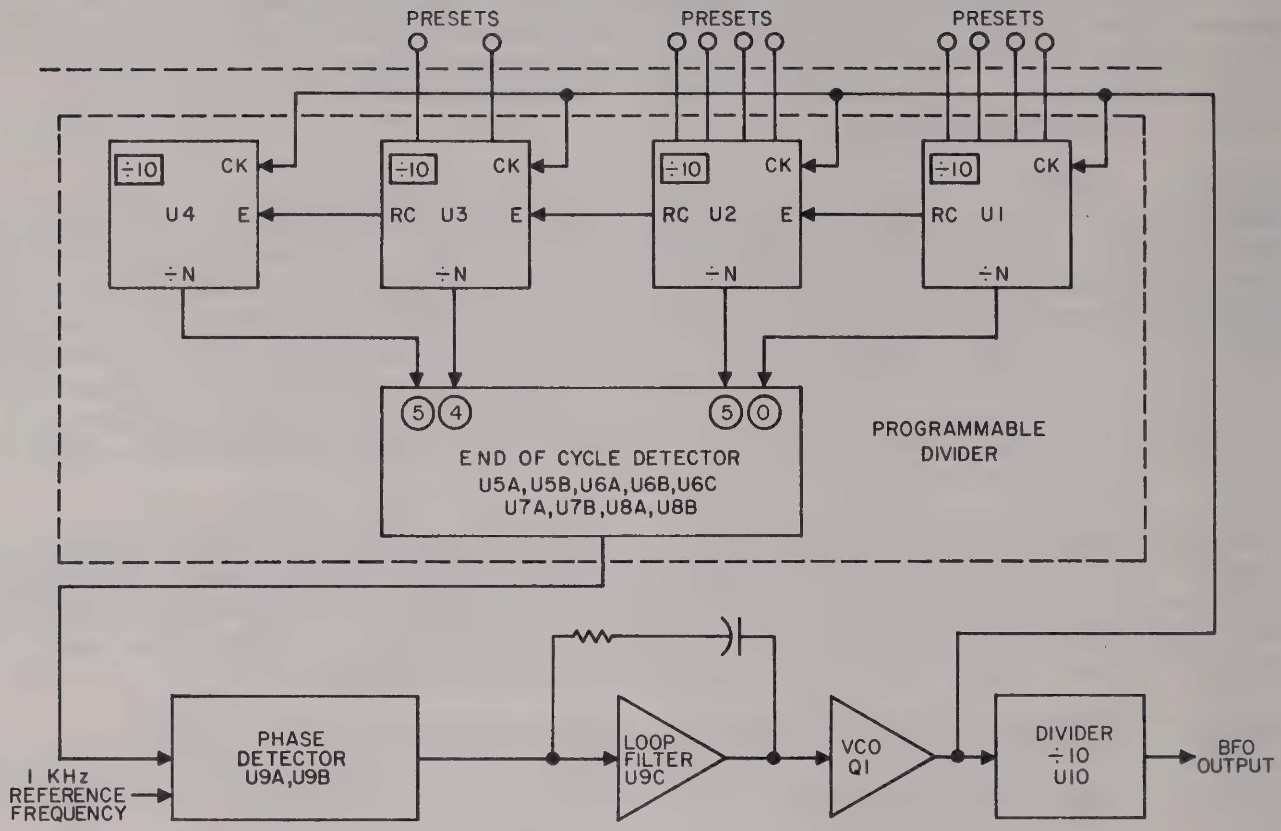


Figure 3-13. BFO Functional Block Diagram

Refer to Figure 3-13 to aid in the description of the counters used in the programmable divider. U1, U2, U3, and U4 are BCD synchronous up/down counters. These counters may be programmed, through inputs D, C, B and A, for any initial state, 0 through 9. The ripple clock output and count enable input permit cascading. The ripple clock output, normally high, produces a low level pulse when the counter is at 9 when counting up, and at 0 when counting down. A high at the enable input inhibits counting while a low level input enables counting. The direction of count is determined by the level of the up/down (U/D) input. When low, the counter counts up, and when high, it counts down. The preset function is controlled by the state of the load inputs. When a logic low is applied to the load input, the BCD number at the preset inputs (D, C, B and A) is loaded into the counter, and counting will begin from that number.

The programmable divider must produce an output of 1 kHz for any input signal in the range of 4.461 to 4.639 MHz. Therefore, the divide ratio of the programmable counter must be from 4461 (4.461 MHz ÷1 kHz) to 4639 (4.639 MHz ÷1 kHz). Because counters U1 through U4 are cascaded (by connecting the ripple clock of one to the enable of another) and have a maximum count of 10000 (10x10x10x10), additional circuitry is needed to reduce the divide ratio.

To reduce the maximum count, an end-of-cycle detector circuit is used to terminate the count sequence. The end-of-cycle detector, consisting of U5A, U5B, U6A, U6B, U6C, U7A, and U7B terminates the counting of U4, U3, U2, and U1 at 5450. When this number is detected, a pulse is sent to the phase detector (U9) and the counters are reset.

Now that a terminal count has been established, an explanation of the presettable inputs follows. The preset of U4 is always set (hard wired) to 0000. U3 has two preset inputs which depend on the direction of counting. These inputs to U3 connect to the plus or minus (±) thumbwheel switch for variable BFO selection. Selecting a negative (-) BFO frequency enters a 1001 into U3 and the counters count up. Selecting a positive (+) BFO frequency enters a 0000 into U3 and the counters count down. U2 has nine possible preset input states from BCD 0000 to 1000. U1 has ten possible preset states from 0000 to 1001. These possible preset states are determined by the setting of the BFO switch. Selecting a zero BFO offset (±0.0 kHz) grounds all preset inputs of U1 and U2, loading both counters with 0000. Also, selecting a "0" from the "+, 0, -" thumbwheel grounds all thumbwheel preset inputs causing a zero BFO offset. In all sideband modes, the BFO offset line is grounded, in turn grounding the presets of U1 and U2 and loading them with 0000. Refer to the BFO Switch Truth Table, Table 3-11, for further clarification of the BFO Switch operation.

Knowing the possible input values of the divider and the end-of-cycle detection number, an example will help explain the count sequence (refer to Figure 6-18). Assume that counters U4, U3, U2, and U1 are all loaded with 0000. This corresponds to a BFO frequency of 455 kHz, a VCO frequency of 4.55 MHz, and a BFO thumbwheel setting of 0.0 kHz. A "+" thumbwheel setting initiates down counting. Therefore, counting from 0000 down to 5450 results in a divide ratio of 4550. (Note that the next count down from 0000 is 9999). With a divide ratio of 4550, the counters will reach a terminal count 1000 times a second with an input frequency of 4.55 MHz.

Notice that setting the thumbwheel switches to -0.0 kHz indicates the same VCO frequency, 4.55 MHz, but initiates "up" counting. A negative "-" setting enters a 1001 (BCD 9) in U3, making the count start from 0900. With an input of 0900 counting up to 5450 results in the same divide ratio of 4550.

Assume a BFO frequency of 460.4 kHz is needed. This corresponds to a thumbwheel selection of +5.4 kHz, and a VCO frequency of 4.604 MHz. From the thumbwheel selection, a "+" presets U3 with a 0000, a "5" presets U2 with a 0101, and a "4" presets U1 with a 0100. Therefore, counting from 0054 down to 5450 results in a divide ratio of 4604. With a divide ratio of 4604, the counters will reach terminal count 1000 times a second with an input frequency of 4.604 MHz.

U8A and U8B have two purposes: to send a pulse to the LOAD input of the counters for presetting and to extend the width of the end of cycle detector's pulse.

The phase detector, U9A, receives a fixed 1 kHz frequency at its reference input, pin 1, and a signal from the divider at its variable input, pin 3. These two signals produce an output that characterizes their differences in frequency and phase. The charge pump, U9B receives this pulsed waveform from the phase detector outputs and translates them to fixed positive and negative-going amplitude levels (centered about 1.5 V).

These levels are filtered and integrated by the loop filter, Q4 and U9C, providing the tuning voltage for the VCO. A more complete description of the phase detector can be found in paragraph 3.3.2.4.

Buffer Q4 provides a high-input impedance for the preceeding stage. Positive and negative going pulses at the gate are developed across the source output and applied to inverting amplifier U9C. The output of U9C is coupled back to the gate of Q4, through R3 and C1, providing the integrating action. Potentiometer R1 establishes zero gate to source voltage (Vgs) to Q4.

Emitter-coupled oscillator Q1 with its external tank circuit comprises the VCO. Varactor diode CR1 receives a control voltage from the active filter and adjusts the tank circuit's frequency of oscillation to establish lock. The VCO operates from 4.461 to 4.639 MHz. Resistors R8, R9, and R10 form the dc bias network, and feedback capacitor C7 sustains oscillation along with tuned circuit C8 and L1. R11 and C9 form a low-pass filter for +15 V isolation, and the VCO's output is coupled to the next stage by C10.

Q2 and its surrounding components form a tuned amplifier for the incoming VCO output frequency. This VCO sine-wave frequency is then coupled to a sine-wave to TTL converter, Q3. From here, the digital signal returns as the clock input of the programmable divider, and is divided by 10 in U10 and provided as the BFO output signal.

3.3.6 TYPE 791601 2ND LO SYNTHESIZER (A5A2)

3.3.6.1 Functional Description

The 2nd LO tunes from 32.20001 to 32.21000 MHz in 10 Hz steps. This synthesizer utilizes three phase lock loops to produce the 2nd LO output. The functional block diagram of the 2nd LO is shown in Figure 3-14.

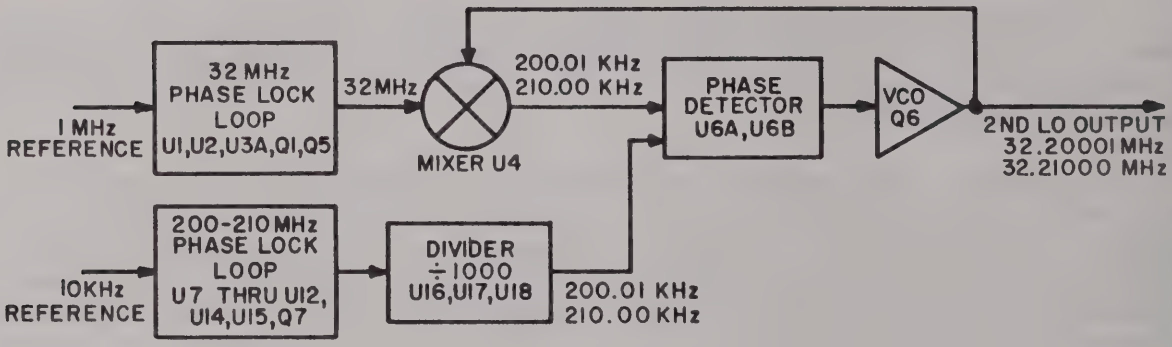


Figure 3-14. 2nd LO Functional Block Diagram

The phase lock loop in the upper left section of the diagram has a reference input of 1 MHz from the Time Base and a fixed output of 32 MHz. The bottom phase lock loop is programmable and produces an output from 200 to 210 MHz. This output routes through a divide-by-1000 stage, resulting in a programmable output from 200 to 210 kHz. The third phase lock loop depends on the other two phase lock loops to produce the 2nd LO output.

An explanation of the 2nd LO output loop will clarify the overall operation of this synthesizer. The 2nd LO output routes to mixer U4, where it is mixed with the fixed-frequency phase lock loop output of 32 MHz. This mixer produces the difference of its two input frequencies, resulting in an output within the 200 to 210 kHz range. This output is amplified and level translated for TTL compatibility. Mixer output and divide-by-1000 output signals are compared in frequency and phase by U6A, whose output characterizes the difference between its two inputs. Filter U6B integrates the phase detector output into a varying dc voltage which drives the VCO to establish the desired frequency. The VCO output is sent through a buffer amplifier whose output is the 2nd LO.

3.3.6.2 Circuit Description

The circuit description for the 2nd LO follows the same organization as the functional description. The 2nd LO will be discussed in the following order: 32 MHz phase lock loop, programmable phase lock loop, and 2nd LO output loop. The schematic diagram for the 2nd LO is shown in Figure 6-17.

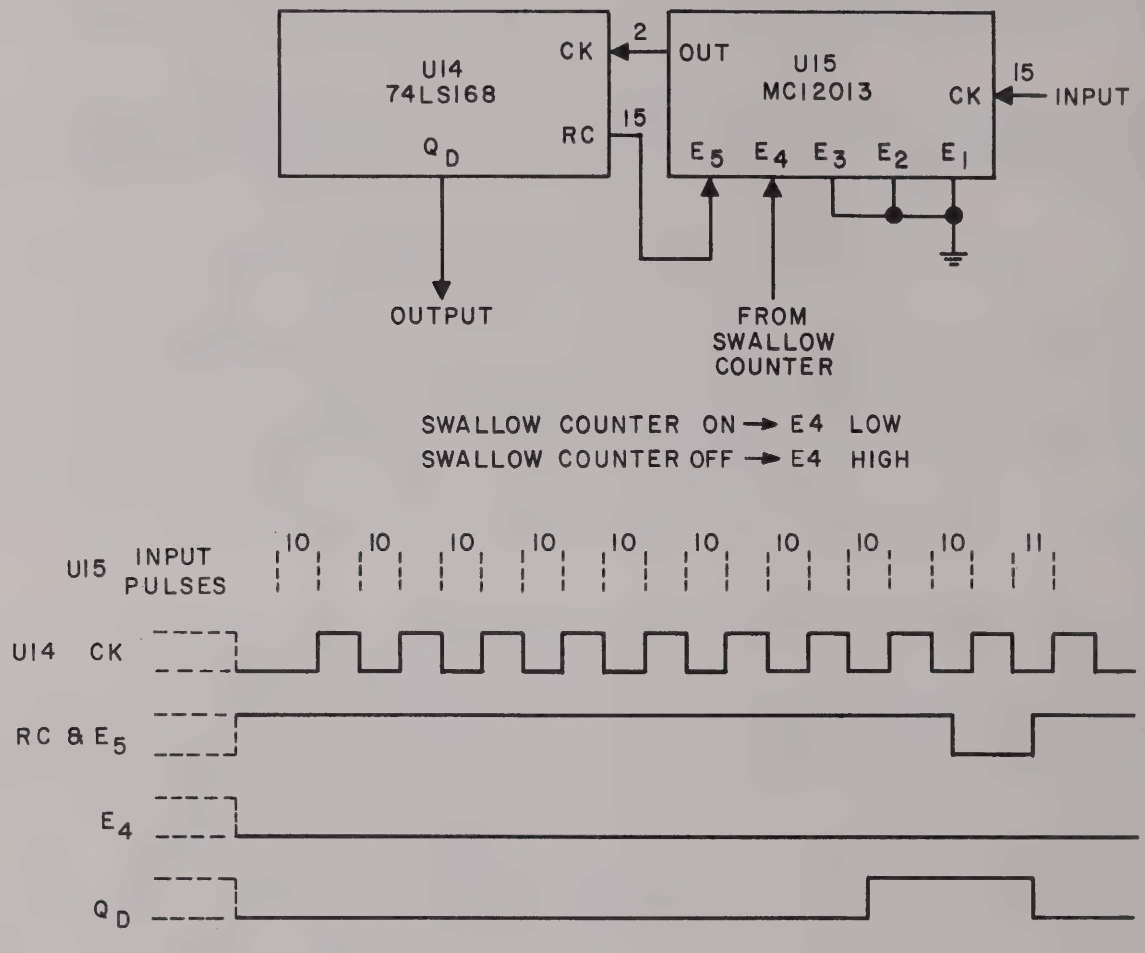
The 32 MHz phase lock loop utilizes the basic phase lock loop configuration shown in Figure 3-5. The VCO output (from oscillator Q5) is applied to buffer amplifier Q1. The collector output of Q1 routes through a divide-by-2 counter, U3A, and a divide-by-16 counter, U2, dividing the 32 MHz output down to 1 MHz. This signal and the 1 MHz reference from the time base are compared in phase detector U1A, and filtered in U1B (these circuits are described in paragraph 3.3.2.4). The dc voltage from U1B varies the capacitance of varactor diode CR3. Q5's oscillation frequency depends on the tuned circuit incorporating CR3. Q1 is a buffer amplifier which has two outputs isolated from each other. C9 and L9 passes the 32 MHz emitter signal to the mixer while rejecting any harmonics of 32 MHz or any 1 MHz signals from the input of U4. The collector output is returned to the counter to close the loop.

The programmable phase lock loop incorporates a two-modulus prescaler, swallow counter, divider, phase detector, filter, and VCO. The output of this loop, from Q7, feeds into U15 and U16. U14 and U15 form a prescaler whose divide ratios are 100 and 101. Figure 3-15 illustrates the prescaler operation. Individually, U15 is a divide-by-10 or 11 counter and U14 is a divide-by-10 counter. Cascading the two counters results in divide ratios of 100 and 101. This needs additional modifications. U15 divides by 11 when both E5 and E4 are at a low state. This occurs only during the swallow counting sequence when E4 is held low by U11C. U15 divides by 10 for 90 input pulses from the VCO. Because of this, nine input pulses enter U14 at pin 2. At this point U14's ripple clock output, pin 15, goes low for one input pulse. This enables U15 to divide by 11 once. Therefore, dividing by 10 nine times (9x10) and dividing by 11 once (1x11) results in a divide ratio of 101 (90+11). This division of 101 occurs until the swallow counter (U7 and U8) reaches terminal count. From this point, E4 of U15 remains high until the divider reaches terminal count, thus dividing by 10. U11B and U11C detect the state of the swallow counter while U11D detects the terminal count of the divider.

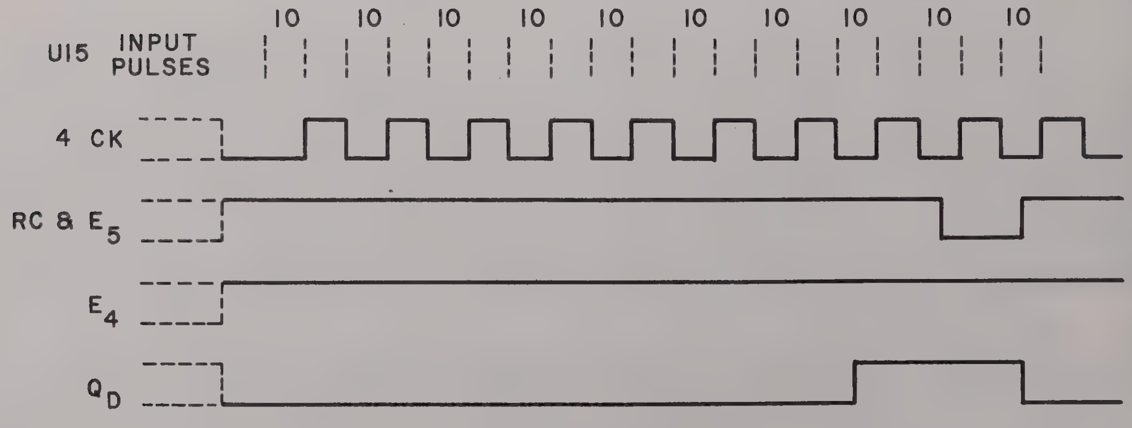
The swallow counter is comprised of U7 (a decade counter) and U8 (a binary counter). U11A, B, and C form the swallow counter terminal count detector. The counter can be loaded with any number between 00 and 99, inclusive. During a load pulse U7 and U8 are loaded, and the output of the NAND latch formed by U11B and U11C is reset. This low signal is sent to the prescaler control input of U15, causing it to divide by 101. When U8 reaches state 1010, sensed by U11A, the NAND latch will be set causing the prescaler to divide by 100. As soon as U8 is clocked to state 1010, U7 will be in 0000 state because up counting is used. Since detection occurs when U7 is 0 and U8 is 10, the terminal count for the swallow counter is 100.

The main programmable counter consists of binary counters U9 and U10. U11D is used as the detector. U9 can be loaded with any value between 0 and 9, and U10 is always loaded with 2. Since binary counters are used, the 2 loaded in the second digit is not worth 20 (2x10), but is worth 32 (2x16). U11D senses a high level on the QA output of U9 and the minimum/maximum output of U10. The first time this occurs while up counting is when U10 and U9 are in states 15 and 1, respectively. Again the 15 in the second digit is worth 240

(15x16), so the terminal count is 240 + 1 = 241. Each count of the programmable counter is equal to 100 counts of the overall divide chain so the actual terminal count for the programmable counter is 241 x 100 = 24100.



DIVIDE-BY-101



DIVIDE-BY-100

Figure 3-15. 2nd LO Prescaler Timing Diagram

Combining the terminal counts of both counters will yield the overall terminal count. The terminal count for the swallow counter was 100 and for the programmable counter was 24100. Therefore, the terminal count for the whole chain is 100 + 24100 = 24200. The programmable counter is always loaded with 32 plus the input to U9 so the overall chain is loaded with 3200 (32x100) plus the inputs to the three stages.

Suppose 000 is loaded into the 2nd LO. The input to the counters is 3200 + 000 = 3200. The terminal count is 24200, so the divide ratio is 24200 - 3200 = 21000. Suppose 999 is loaded. The input is 3200 + 999 = 4199. The divide ratio is 24200 - 4199 = 20001. Suppose 500 is loaded. The input is 3200 + 500 = 3700. The divide ratio is 24200 - 3700 = 20500.

Assuming lock is achieved, a 10 kHz signal should be seen at the output of U11D. This signal is compared to a 10 kHz reference frequency from the Time Base, in phase detector U12A, and filtered in U12B (these circuits are described in paragraph 3.3.2.4). The dc voltage from U12B varies the capacitance of varactor CR5 which varies the frequency of oscillator Q7. This signal, ranging from 200.01 MHz to 210.00 MHz, feeds the prescaler and routes to a divide-by-1000 circuit. U16, U17, and U19 each are divide-by-10 counters. When cascaded, the circuit provides a division ratio of 1000 (10x10x10). The input to U6A is a signal ranging from 200.01 kHz to 210.00 kHz.

The 2nd LO output loop produces the 2nd LO frequency range of 32.20001 to 32.2100 MHz in 10 Hz steps. This range of frequencies and the 32 MHz signal from Q1 mix in U4, resulting in a difference frequency range from 200.01 kHz to 210.00 kHz.

Differential amplifier U5 accepts the push-pull output from U4 and amplifies the signal approximately 10 times into a single-ended output. Q2 translates the output level of U5 to TTL levels for the input to U6A. This signal and the phase locked frequency from the programmable divider are compared in phase detector U6A, producing dc voltages that are filtered by U6B (these circuits are described in paragraph 3.3.2.4). U6B's output varies the capacitance of varactor diode CR4 and tunes oscillator Q6. This output enters a buffer amplifier, Q3, where the signal is output to mixer U4, and is coupled through impedance matching voltage divider C22, C23, to become the 2nd LO output.

3.3.7 TYPE 791600 1ST LO SYNTHESIZER (A5A1A2)

The 1st LO Frequency Synthesizer circuits are part of the 1st and 3rd LO/Time Base circuit board. The 1st LO utilizes a phase lock loop configuration with the prescaling technique previously described in paragraph 3.3.2.3. The output of the 1st LO tunes in 10 kHz steps from 42.91 MHz to 72.90 MHz. This tuning range mixes with the 0.0 to 29.99 MHz receiver tuning range to produce a 1st IF signal in the range of 42.90 to 42.91 MHz. A block diagram of the 1st LO is shown in Figure 3-16.

3.3.7.1 Functional Description

The programmable divider, phase detector, and lead-lag filter of the 1st LO Synthesizer are contained on the main circuit board (Type 791600); the VCO and tuning voltage control circuits (Type 791629) are mounted separately, but together with the main circuit board, they form a combined assembly. The phase detector (U5), charge pump (U6C), and lead-lag filter (U7) of the 1st LO will be discussed lightly since a detailed description of these circuits can be found in paragraph 3.3.2.4 of the phase lock loop section. Refer to Figure 3-16 for the following discussion.

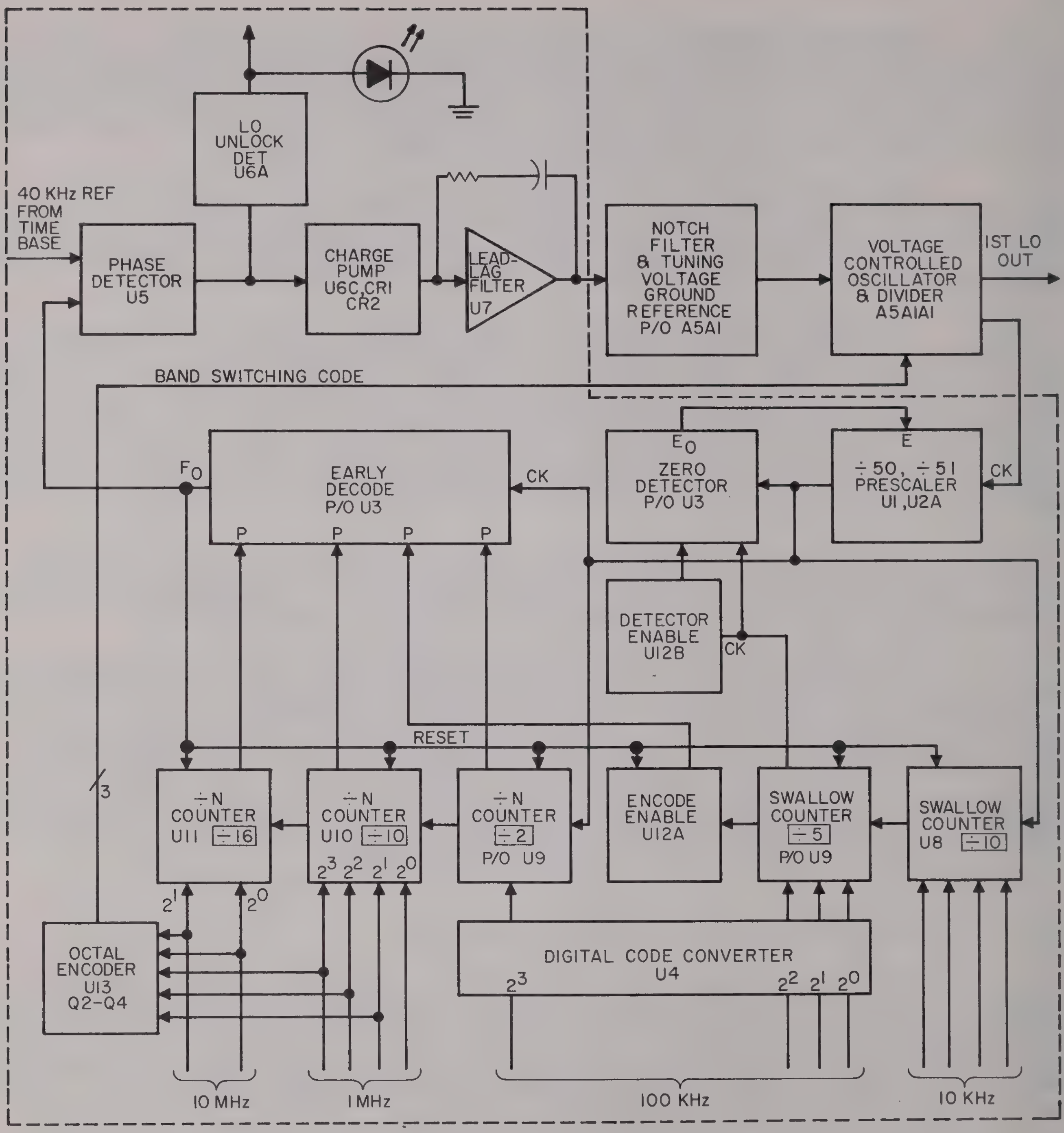


Figure 3-16. 1st LO Functional Block Diagram

A two-modulus prescaler (described in paragraph 3.3.2.3) is used at the input to the divide-by-N counter to divide down the frequency from the VCO so that it can be handled by conventional low-power Schottky counters. If the 1st LO is locked on the correct frequency, the output of the programmable counter will be 40 kHz. This 40 kHz is compared to the 40 kHz reference frequency from the Time Base in phase detector U5. The difference in frequency and phase of these two input signals produces a series of pulses which the charge pump converts to positive or negative going voltages. These voltages are integrated by lead-lag filter U7 to provide the tuning voltage for the VCO. The Notch Filter and Tuning Voltage ground reference circuits isolate the VCO tuning voltage from any ripple from the 40 kHz reference frequency. An octal band-switching code, generated by octal encoder U13 from the divider section, switches the VCO to one of eight tuning ranges spaced 16 MHz apart.

The VCO has two inputs and two outputs. The inputs to the VCO are a tuning voltage and a band-switching code. Together they supply the VCO with the necessary information for tuning to the correct frequency. The actual VCO generates frequencies between 171.64 MHz and 291.60 MHz. This range is sent to the programmable divider of the phase lock loop. The other output of the VCO is applied to a frequency divider. Since the 1st LO frequency range is from 42.91 MHz to 72.90 MHz, the VCO frequency range must be divided by 4. For this same reason, the eight tuning ranges of the VCO (from the band switching code) are spaced 16 MHz apart within the VCO and 4 MHz apart (16 MHz ÷ 4) for the 1st LO output. In summary, the VCO frequency is four times that of the 1st LO output frequency.

The programmable divider has an input range from 171.64 MHz to 291.60 MHz, in 40 kHz steps, and must divide each of these frequencies down to exactly 40 kHz. This condition calls for the programmable divider to have a divide ratio from 4291 (171.64 ÷ 40 kHz) to 7290 (291.60 MHz ÷ 40 kHz).

From the conditions above, the counters within the programmable divider, U8, U9, U10 and U11, must have a divide range from 4291 to 7290. The inputs of the counters are always preset from the BCD equivalents of the four most significant digits of the tuned frequency. This range is from 0000 to 2999. One other condition exists at the input to the counters; U11 is wired to automatically add 8 to its preset. Therefore, the VCO presets have a range from 8000 to 10999. The external logic circuits connected to the counters stop the counters from counting when they reach the terminal count number 3709. Since the counters are wired to count down, the overall divide range needed from the counters is obtained; the divide range is from 4291 (8000-3709) to 7290 (10999-3709).

3.3.7.2 Circuit Description

3.3.7.2.1 Counting Cycle

Although the counters have the correct divide range needed to divide the input frequency down to 40 kHz, the VCO output frequency is too high for the counters to operate properly. Therefore, a high-speed, two-modulus prescaler is used to divide the input frequency to a range that can be handled by the counters.

The prescaler used in the 1st LO divides either by 50 or 51. In order for the counters to divide correctly, they must divide in increments of 50 or 51 also. When the prescaler divides by either 50 or 51, only one pulse is sent to the counters. Therefore, the counters must interpret this pulse as representing either 50 input pulses or 51 input pulses.

The counter section shown in Figure 3-16 is divided into two parts: a programmable counter and a swallow counter. The programmable counter consists of U11, U10, and part of U9, and the swallow counter consists of U8 and part of U9. Both counters receive the same clock pulse from the prescaler output. By having the swallow counter control the prescaler, the represented count will decrement by 51 when the programmable counter and the swallow counter are counting. When the swallow counter reaches terminal count, the prescaler will begin to divide by 50 and the swallow counter will be disabled for the remainder of the cycle.

Figure 3-17 shows graphically a typical 1st LO counting cycle. The prescaler divides by 51 until the swallow counter reaches terminal count. When the outputs of the swallow counter reach this state, they cause the zero detector's E_0 output state to become high. This causes the prescaler to divide by 50 until the end of the count cycle. Since the programmble counter is separately clocked, it continues to count down until its terminal count is detected by the early decode circuit. When this occurs, the $\overline{F_0}$ output of the early decode goes high after the next clock pulse from the prescaler. This is the output pulse supplied to the phase detector. When the output from the early decode circuit again goes low, it resets the counters to the preset number on their inputs. It also causes the reset enable circuit to reset the zero detector circuit causing its output to go low so the prescaler can divide by 51 during the next count cycle.

Refer to the schematic diagram of the 1st LO, Figure 6-16, to aid in understanding the circuit descriptions presented below.

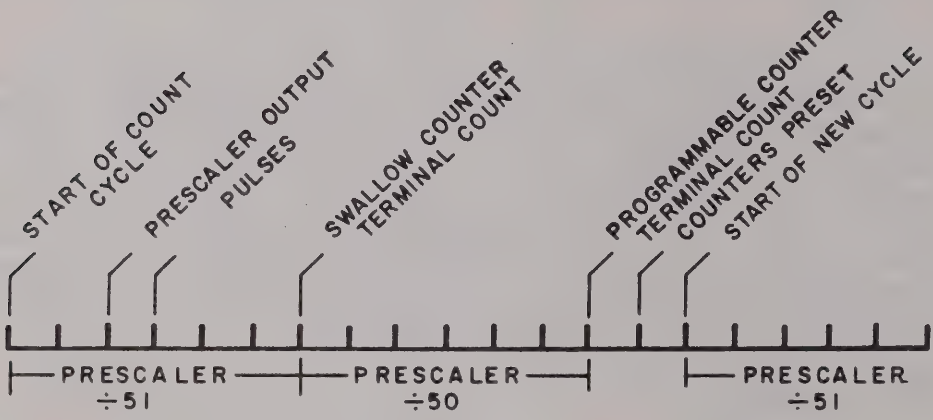


Figure 3-17. 1st LO Counting Cycle

3.3.7.2.2 Prescaler, U1 and U2A

The prescaler input frequency ranges from 171.64 MHz to 291.60 MHz. The prescaler divides this by 50 or 51, depending on the states of the E inputs of U1. Figure 3-18 illustrates the prescaler's operation. U1 is a divide-by-10/11 counter and U2A is a divide-by-5 counter. The prescaler divides by 51 when E4 is low and when E5 pulses low once for every five pulses from U2A. E5 is low for only one count out of five so the complete count cycle of U1 and U2A takes 51 counts (4 x 10 + 1 x 11). This count cycle continues until the swallow counter reaches terminal count. E4 then goes high and U1 divides by 10 only, giving U1 and U2A a complete count cycle of 50.

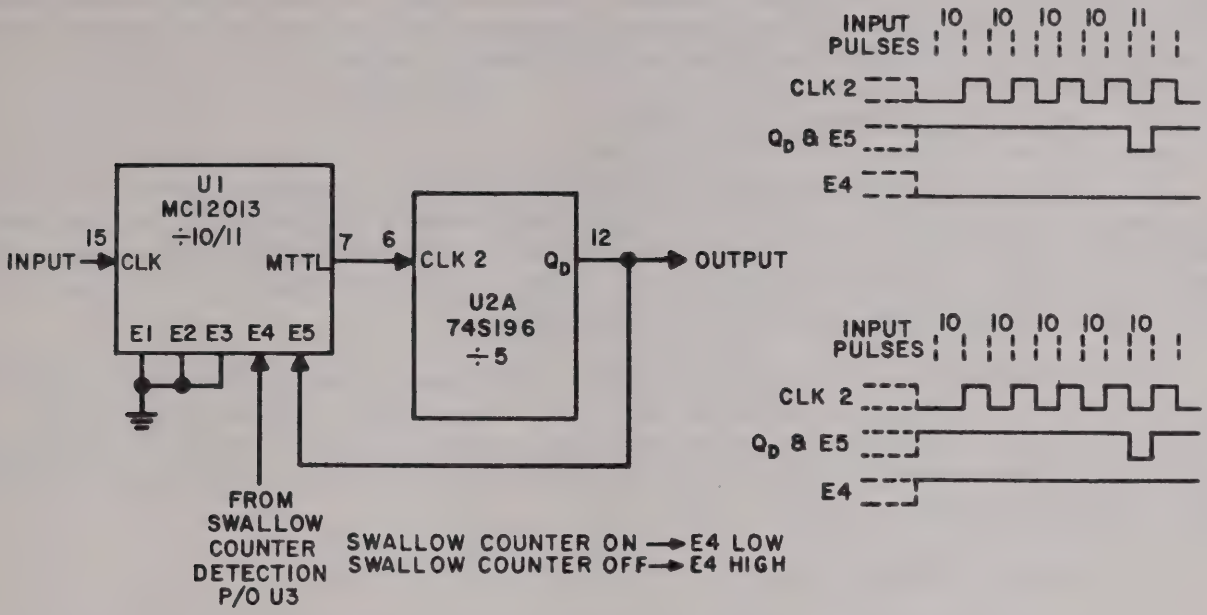


Figure 3-18. 1st LO Prescaler Timing Diagram

3.3.7.2.3 Digital Code Converter U4

U4 is a programmable ROM (Read Only Memory) that serves as a decoder or code converter. It behaves as a look-up table to translate a BCD input, which has bit values of 2^3, 2^2, 2^1, 2^0, to a new code with bit values of 5^1, 2^2, 2^1, 2^0. Table 3-6 illustrates all possible inputs and outputs of U4.

Table 3-6. Code Converter U4, Truth Table

BCD INPUTS TO U4				OUTPUTS FROM U4			
2^3	2^2	2^1	2^0	5^1	2^2	2^1	2^0
D	C	B	A	Y_4	Y_3	Y_2	Y_1
0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	0	0	1
0	1	0	1	1	0	0	0
0	1	1	0	1	1	0	0
0	1	1	1	1	0	1	1
1	0	0	0	1	0	1	0
1	0	0	1	1	0	0	1

U4 serves as part of the programmable counter and part of the swallow counter. Output Y_4 presets the divide-by-2 counter, which is part of the programmable counter. Outputs Y_1, Y_2, and Y_3 preset the divide-by-5 counter which is part of the swallow counter. The function of U4 in each counter section will be discussed below.

3.3.7.2.4 Programmable Counter U9, U10, U11

The programmable counter is formed by U11, U10, and part of U9. U11 and U10 count down and U9 counts up. U10 is a divide-by-10 counter (BCD). U11 is a divide-by-10 counter (BCD). With the D input of U11 tied high (to Vcc 3), the counter is always preset with at least 8 (1000). The divide-by-2 counter within bi-quinary counter U9 is part of the programmable counter, using preset input A and output QA.

U11, U10, and U9 are cascaded with a clock input entering U9 at pin 8 (CLK1). U9 cascades to U10 and clocks U10 on its the 0 to 1 transition. U10 cascades to U11. The programmable counter counts from its preset values on U11, U10, and U9 down to a detection number of 370 (0011, 0111, 0000). A carry condition is the only exception to this count sequence and will be discussed later.

3.3.7.2.5 Swallow Counter U8 and U9

The 1st LO swallow counter is formed by decade counter U8 and the divide-by-5 part of bi-quinary counter U9. Cascaded, they form a divide-by-50 counter which controls the divide mode of prescaler U1. The counting mode of the swallow counter is unusual, in that U8 counts down and clocks U9, which counts up. Refer to Table 3-7. The terminal count for the swallow counter occurs at 09. At this point the Z inputs of control device U3 must all be low. However, the $\overline{Z_0}$ input is controlled by U12B, which enables detection of the terminal count. The Q output of U12B is set high at the beginning of each count cycle, and will not go low until the most significant swallow counter digit, from U9, steps from 1 to 2. This clocks U12B, validates the terminal count, and the prescaler mode will be changed when the counter reaches 09. Therefore, for preset values between 29 and 40, the counter cycles past the first 09 count to the 10 to 29 transition, then terminates at 09.

3.3.7.2.6 Carry Condition U12A and U6B

A carry condition occurs in the programmable counter when the preset to the swallow counter falls into the range of 29 to 00. Refer to Table 3-7. If the preset to the swallow counter is 00, the first count will cause the transition to 19. When this occurs, the U9 output Q_B will go high, while Q_C remains low. The logic of U24B and U24A produces a logic high to clock U12A. The Q output of U12A is preset high at the beginning of each cycle, but if the 00 to 19 transition occurs, it is clocked low. This applies a logic low to NAND gate U6B, and effectively shifts the actual terminal count of the programmable counter from 370 to 371. (The actual number detected is 380 or 381, for reasons explained later, in 3.3.7.2.7.)

3.3.7.2.7 Count Sequence

Table 3-8 illustrates the count-down sequence of the 1st LO divider for two example RF input frequencies. In the first example, the receiver is tuned to 00.00XXX MHz and the 1st LO counter presets are loaded with the value 8000, as explained in 3.3.7.1. The two most significant preset digits (8 and 0) are loaded directly into U11 and U10. The least significant digit (0) is loaded directly into U8. The 0 applied to code converter U4 results in a 0 preset to both sections of U9, as explained in 3.3.7.2.3. The swallow counter (U8, U9B) and the programmable counter (U9A, U10 and U11) are both decremented by 1 prescaler output pulse

Table 3-7. Count Sequence, 1st LO Swallow Counter

÷5 U9B (UP)	÷10 U8 (DOWN)	COMMENTS	÷5 U9B (UP)	÷10 U8 (DOWN)	COMMENTS
0	0	THIS TRANSITION	3	4	
1	9	SETS CARRY CONDITION	3	3	
1	8	(U8 clocks U9)	3	2	
1	7		3	1	
1	6		3	0	
1	5		4	9	U8 clocks U9
1	4		4	8	
1	3		4	7	
1	2		4	6	
1	1		4	5	
1	0	SWALLOW COUNTER	4	4	
2	9	VALIDATE (U8 clocks U9)	4	3	
2	8		4	2	
2	7		4	1	
2	6		4	0	
2	5		0	9	TERMINAL COUNT
2	4		0	8	(U8 clocks U9)
2	3		0	7	
2	2		0	6	
2	1		0	5	
2	0		0	4	
3	9	U8 clocks U9	0	3	
3	8		0	2	
3	7		0	1	
3	6		0	0	Repeat Cycle
3	5		1	9	U8 clocks U9

for each 51 prescaler input pulses. When the swallow counter reaches its terminal count (at 09) the prescaler divide mode changes to ÷50. Since the swallow counter was preset with 00, a carry condition exists and the terminal count for the programmable counter is 371, as explained in 3.3.7.2.6. When the programmable counter reaches terminal count, the cumulative number of pulses into the prescaler equals 4291. Since the loop reference frequency is 40 kHz, the VCO frequency is 4291 x 40 kHz, or 171.64 MHz. The VCO output to the mixer is divided by 4, resulting in an actual LO output of 42.91 MHz. This is the LO frequency corresponding to a tuned RF of 00.00XXX MHz.

The second example in Table 3-8 shows the receiver tuned to 29.99XXX MHz and the 1st LO counter presets loaded with the value 10999. The two most significant preset digits (10 and 9) are loaded directly into U11 and U10. The least significant digit (9) is loaded directly into U8. The 9 applied to code converter U4 results in a value of 1 applied to U9A, and a value of 1 applied to U9B, as explained in 3.3.7.2.3. Since the swallow counter preset is 19, no carry condition exists and the terminal count for the programmable counter is 370. When terminal count is reached, the cumulative number of pulses into the prescaler equals 7290. With a loop reference of 40 kHz, the VCO frequency is 291.6 MHz, and the actual LO output (291.6 MHz ÷ 4) equals 72.90 MHz. This corresponds to a tuned RF of 29.99XXX MHz.

Table 3-8. 1st LO Divider Count-Down Cycles

Pre-Scaler Mode	Pulses into Prescaler		Prescaler Output Pulses	U9B (÷5)	U8 (÷10)	U11 (÷16)	U10 (÷10)	U9A (÷2)	COMMENTS
	New	Cum.							
÷51	0	0	0	0	0	8	0	0	Preset for Tuned Freq. of 00.00XXX MHz
	51	51	1	1	9	7	9	1	
	51	102	1	1	8	7	9	0	
	408	510	8	1	0	7	5	0	
	51	561	1	2	9	7	4	1	Swallow Ctr. Validation
	1530	2091	30	0	9	5	9	1	Swallow Ctr. Terminal Count
÷50	50	2141	1			5	9	0	
	900	3041	18			5	0	0	
	1000	4041	20			4	0	0	
	100	4141	2			3	9	0	
	50	4191	1			3	8	1	Early Decode
	100	4291	2			3	7	1	Terminal Count (Carry Condition)
	4291 x 40 kHz = 171.64 MHz								Divide Ratio = 4291
÷51	0	0	0	1	9	10	9	1	Preset for Tuned Freq. of 29.99XXX MHz
	51	51	1	1	8	10	9	0	
	408	459	8	1	0	10	5	0	
	51	510	1	2	9	10	4	1	Swallow Ctr. Validation
	1530	2040	30	0	9	8	9	1	Swallow Ctr. Terminal Count
÷50	1000	3040	20			7	9	1	
	1000	4040	20			6	9	1	
	1000	5040	20			5	9	1	
	1000	6040	20			4	9	1	
	1000	7040	20			3	9	1	
	150	7190	3			3	8	0	Early Decode
	100	7290	2			3	7	0	Terminal Count (No Carry Condition)
	7290 x 40 kHz = 291.60 MHz								Divide Ratio = 7290

3.3.7.2.8 Divider Section Terminal Count

The terminal counts of both the swallow counter and the programmable counter are detected by the terminal count control IC, U3. The prescaler mode is controlled by the swallow counter logic outputs applied to the Z inputs of U3, as described in 3.3.7.2.5. The terminal count of the programmable (main) counter is obtained when the correct logic levels are applied to the P and B inputs of U3. As previously stated, the actual terminal count occurs at 370 (or 371, with the carry condition). However, because of the relatively high counting speed, the counters require about two clock pulses to reset at the end of each counting cycle. Therefore, the divider makes use of a two-pulse "early decode" circuit contained in U3. Refer to Figure 3-19.

When the terminal count logic conditions are satisfied (at the P and B inputs) U3 counts one clock pulse, then drops the $\overline{F_0}$ output line low. This resets the flip-flops and presets (loads) the counters. At the end of the second clock pulse, the $\overline{F_0}$ output goes high, starting the count cycle and clocking the VCO phase detector, U5. Therefore, the number detected by U3 is 380 (or 381, in the carry condition) but the actual terminal count is 370 (or 371), because two more prescaler output pulses occur before the $\overline{F_0}$ output goes high.

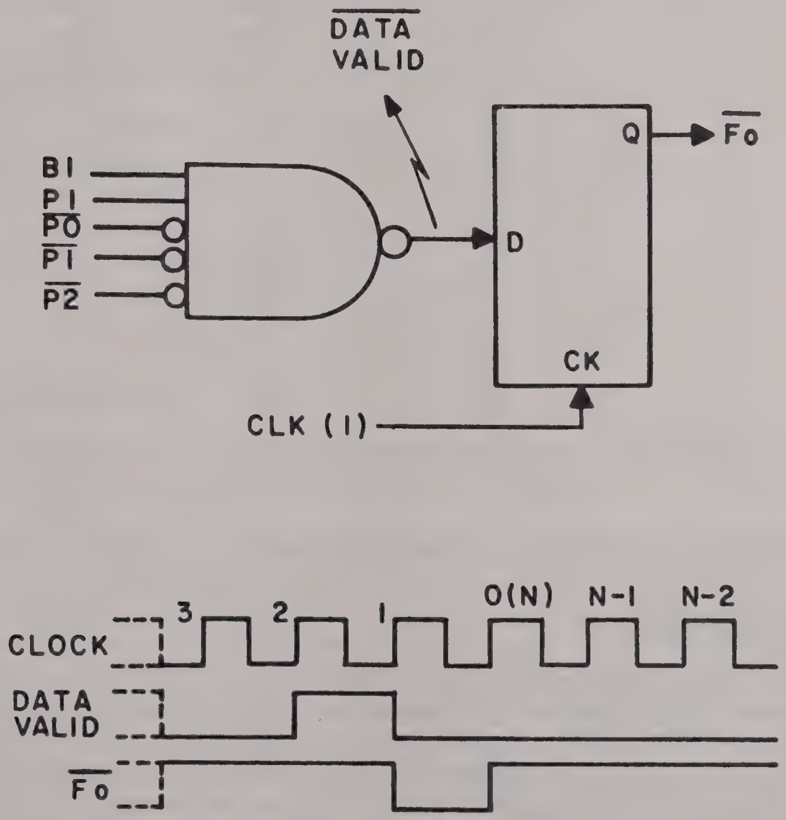


Figure 3-19. Two-Pulse Early Decode, Count Termination

3.3.7.3 VCO Band Select Code

The VCO Band Select circuits are shown in the middle of the 1st and 3rd LO Synthesizer schematic diagram, Figure 6-~~14~~.15 The purpose of U13, Q2, Q3, and Q4 is to translate the 1st LO frequency range into eight different bands for the VCO. The band select code causes different combinations of inductance to be placed across the VCO tuning circuitry, thereby changing the VCO frequency range.

Octal encoder U13 accepts BCD inputs from the two most significant digits of the 1st LO frequency word and translates them into a binary coded word on Y_2, Y_3, and Y_4. The transistors connected to these outputs supply negative true-code outputs. For example, when Y_2 is low, -12 V appears at the base and emitter of Q2 turning the transistor off. This causes the collector to be off and +15 V to appear at output E1. When Y_2 is high, Zener diode CR8 conducts causing Q2 to turn on, resulting in a -12 V potential at output E1. The relationship of the band select code to the LO frequency word is detailed in Table 3-9.

Table 3-9. Band Select Coding

RF Digit		Band Select Code (Negative True)		
10 MHz (U11)	1 MHz (U10)	2^2 (E3)	2^1 (E2)	2^0 (E1)
0	0	0	0	0
0	4	0	0	1
0	8	0	1	0
1	2	0	1	1
1	6	1	0	0
2	0	1	0	1
2	4	1	1	0
2	8	1	1	1

3.3.8 TYPE 791629 VOLTAGE CONTROLLED OSCILLATOR (A5A1A1)

3.3.8.1 Functional Description

Figure 3-20 is the functional block diagram for the Voltage Controlled Oscillator. The VCO is an integral part of the 1st LO Synthesizer loop, whose inputs are a tuning voltage and a band select code, and whose output is the 1st LO frequency. The VCO operates at a frequency four times the desired 1st LO frequency. The band select code and the tuning voltage combine to tune the oscillator from 171.64 MHz to 291.60 MHz in 40 kHz steps. The oscillator output is amplified by Q2 and split between the buffer amplifier and the Divide-by-4 Assembly. Buffer amplifier Q3 provides the synthesizer with a sample of the oscillator signal. The sample is processed and, if required, a correction is made to the tuning voltage. The amplified oscillator frequency is divided by 4 (by U1) since the oscillator frequency is actually four times the desired 1st LO frequency. Amplifier Q7 supplies a high-level signal for the 1st Mixer. A further explanation of the VCO follows.

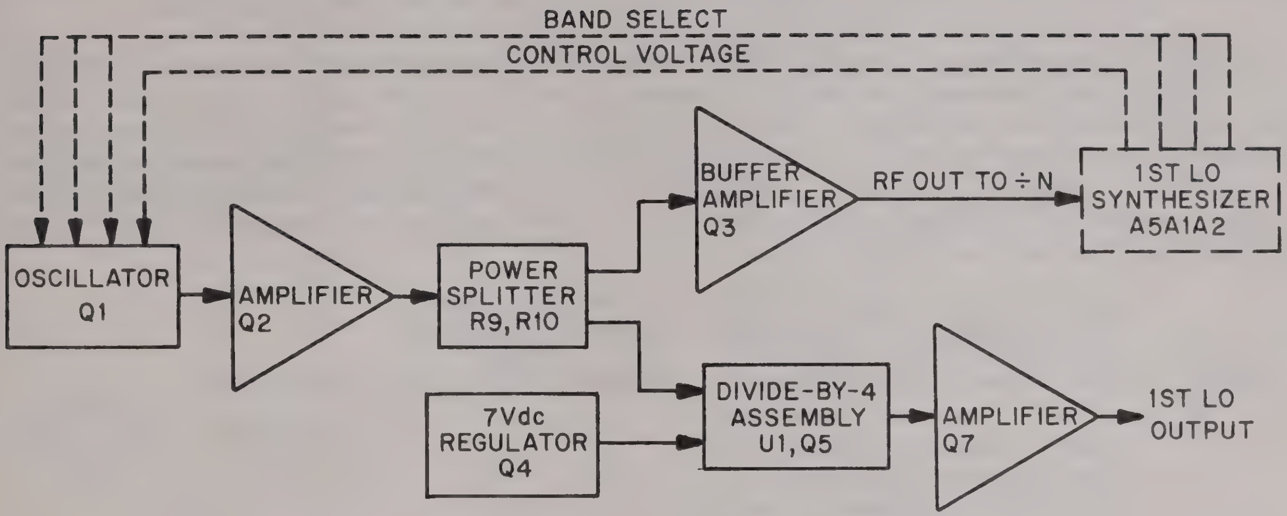


Figure 3-20. VCO Functional Block Diagram

3.3.8.2 Circuit Description

Refer to Figure 6-14 for the schematic diagram of this circuit. This description follows the same organization as the functional description given in the preceding paragraph.

Applying a negative-true-code voltage to the BAND SELECT inputs tunes the oscillator to one of eight different frequency bands. When the BAND SELECT inputs are all positive, CR1 through CR3 are off, and L2 through L4 are effectively out of the circuit. This allows the inductance of T1 to be maximum. When any or all of the BAND SELECT inputs are negative, the corresponding diode will conduct and the inductance of T1 will be reduced by the shunting effect of the inductor (L2, L3, or L4). Varactor diode CR4 fine tunes the oscillator in response to the tuning voltage input. Common-emitter amplifier Q2 keeps load changes at the input of power divider R9 and R10 from being reflected back to the output of oscillator Q1. T2 matches the output of the amplifier to the input of the power divider. The signal is coupled to buffer amplifier Q3, which drives the prescaler of the synthesizer. R9 and C15 couple the signal from Q2 to the input of the divide-by-4 circuit U1. MECL divider U1 divides the signal frequency by four and amplifier Q5 isolates its output from load changes. Voltage Regulator Q4 provides U1 and Q5 isolates with a -7.0 V power input from the -12 V power supply input to the assembly. Amplifiers Q5 and Q7 provide the relatively high currents needed to drive the input of the first mixer.

3.3.9 TYPE 791630 1ST AND 3RD LO SYNTHESIZER/TIME BASE (A5A1)

This assembly is located in the right-hand side of the receiver and connects the 1st and 3rd LO/Time Base circuit board to the 1st LO VCO circuit board. The connections include three lines for the VCO band select code, two lines for the VCO tuning voltage, and one line connecting the VCO output to the 1st LO divider section. Also on this board is a -12 Vdc regulator that supplies voltage to both the 1st LO Synthesizer and the 1st LO VCO.

The schematic diagram corresponding to this circuit board is shown in Figure 6-13. The tuning voltage connects to the VCO through a 40 kHz trap (C1, C3, L1, L2, and L3) and a low-pass filter (C4, C6, C8, R4, and 14). CR1, CR2, and CR3 provide a 1.8 V potential on the tuning voltage reference line. A -15 Vdc potential from the 1st LO circuit board enters pin 3 of the voltage regulator VR1 and is regulated to a -12 Vdc output on pin 2. The -12 Vdc is supplied to the VCO, to power its circuits, and to the 1st LO Synthesizer to power lead-lag filter U7 and the band switching circuit.

3.4 DIGITAL CONTROL SECTION

The Digital Control section is composed of the following circuits:

Manual Tuning Up/Down Counter
Front Panel Interconnect
Manual Tuning Module (optional)
Frequency Display
BFO Switch
Upper Panel Control
Lower Panel Control

Figure 3-21 shows the relationship of these circuits to each other. An explanation of each circuit operation follows. The synthesizers are covered in 3.3.

3.4.1 TYPE 791575-2 MANUAL TUNING UP/DOWN COUNTER (A6A1)

The Manual Tuning Up/Down Counter contains the RF frequency data. This information is sent to the 1st and 2nd LO Synthesizers, and is encoded for multiplexing to the display board. The frequency data can be changed in two ways: from the Manual Tuning Module via front panel control, or from the Remote Input Jack by an external controller. A block diagram of the Up/Down Counter is shown in Figure 3-22. The functions of the Up/Down Counters and the multiplexer are presented below followed by an overall circuit description.

3.4.1.1 Integrated Circuit Data

The 14510 is a presettable up/down decade counter and is shown in Figure 3-23. Pin 15 is the clock input. The counter will increment for each rising edge of the clock when the up/down input (pin 10) is high; when pin 10 is low, the counter will decrement. If the parallel enable input (pin 1) is high, clocking is inhibited and the information on the P inputs are transferred to the corresponding Q outputs. Cascading of counters is accomplished by tying the carry input (pin 5) of one counter to the carry output (pin 2) of the preceding counter and by connecting the control inputs (clock, up/down, parallel enable) in parallel. If the carry input is high, the counter is inhibited from clocking. The carry output, normally high, goes low during a carry condition. Carry conditions occur when the counter is in a 0 state during down counting or when the counter is in a 9 state during up counting. Therefore, any stage in a counter chain will clock only when all preceding stages are in a carry condition.

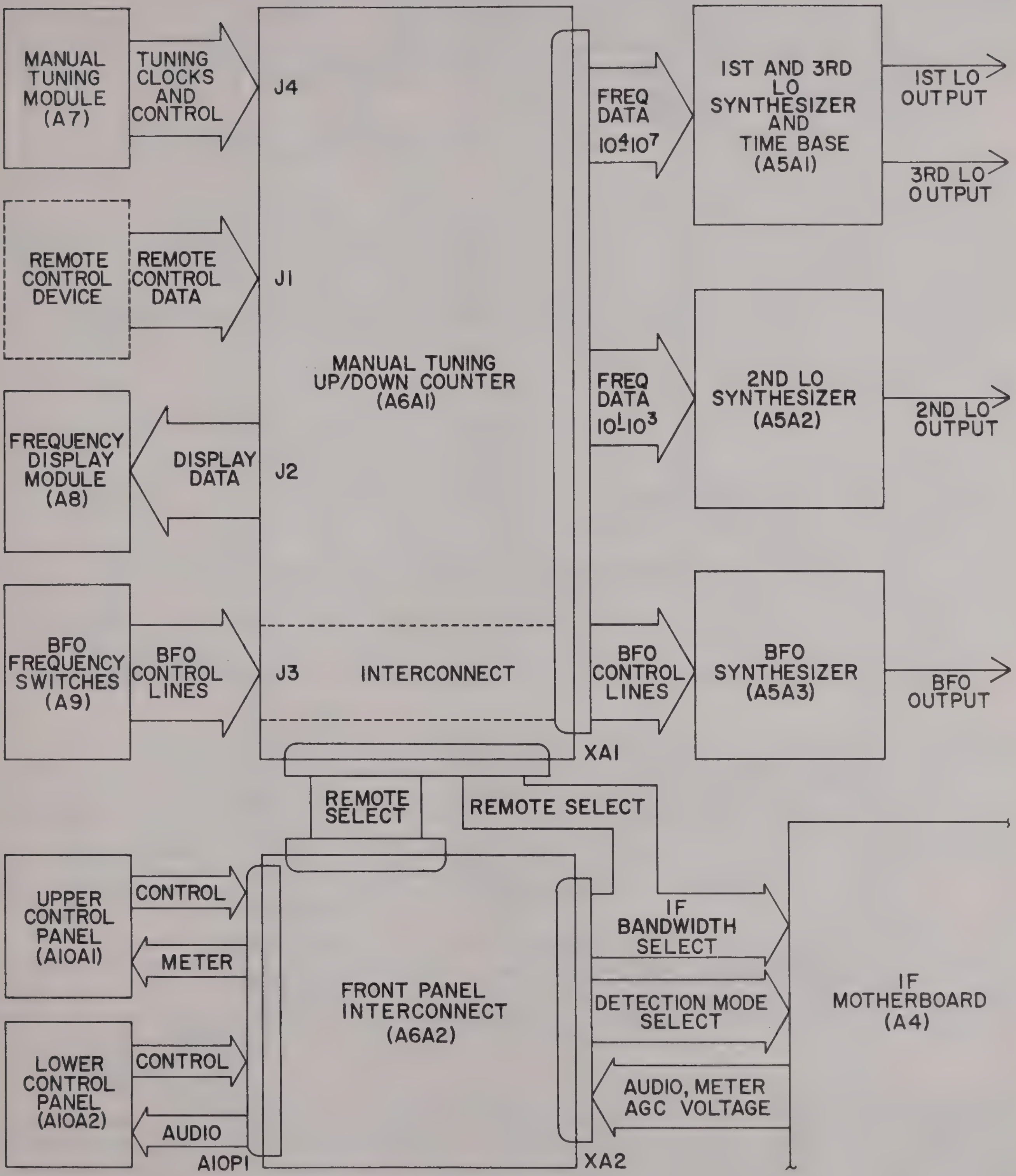


Figure 3-21. Digital Section Functional Block Diagram

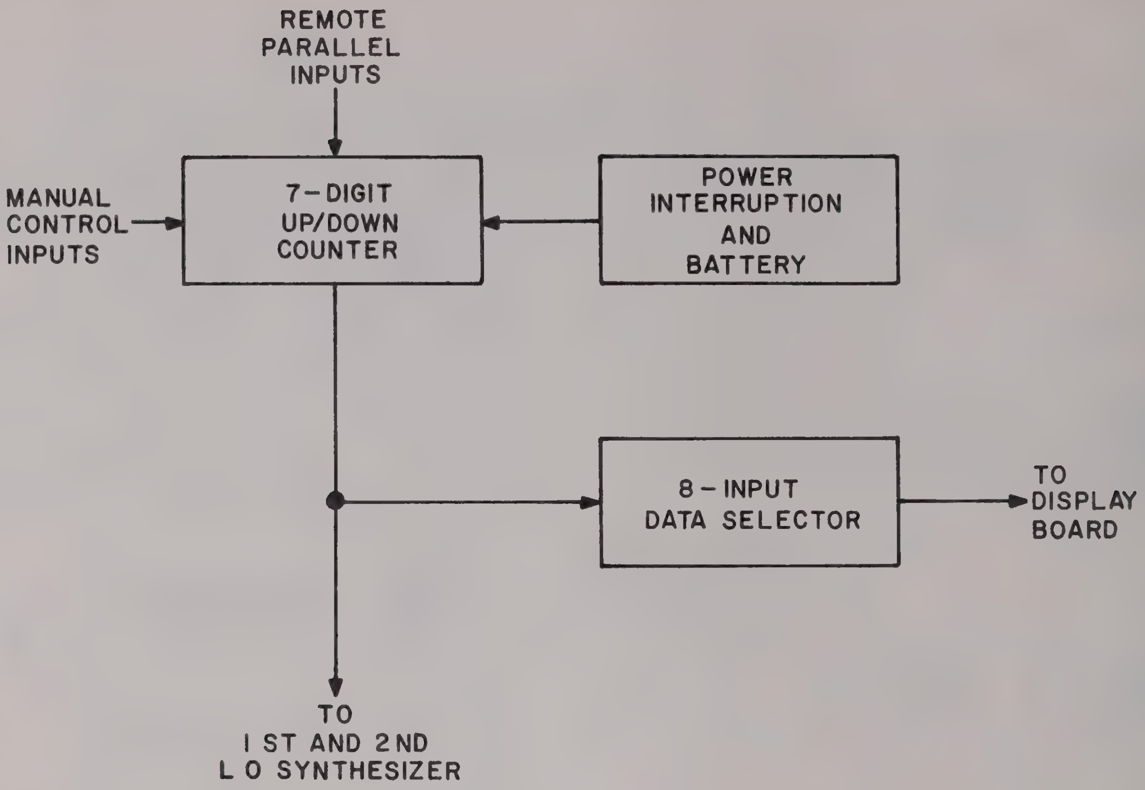


Figure 3-22. Manual Tuning Up/Down Counter Block Diagram

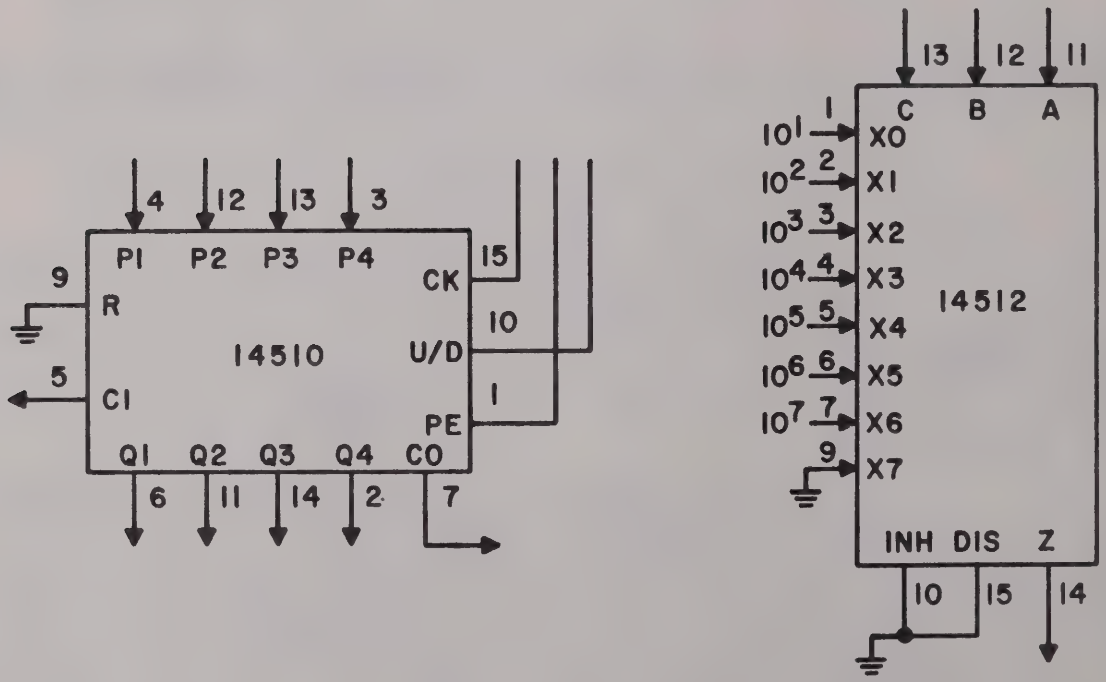


Figure 3-23. Up/Down Counter Integrated Circuit Data

The 14512 is an eight-input data selector and is shown in Figure 3-23. Control inputs A, B, and C select which of the data inputs, X_0 to X_7, is gated to output Z. The data input selected is determined by the binary equivalent of the control inputs. When activated, the disable line will force a low on the Z output and the inhibit input will cause it to go to the high impedance state. Inhibit and disable inputs are not used in this application.

3.4.1.2 Circuit Description

The schematic diagram for this circuit is shown in Figure 6-19. The Up/Down Counter is comprised of U2 through U11. U2 through U7 are MC14510's cascaded to form a six-digit presettable up/down decade counter. U1F, U8C, U9, U10, and U11 form the last stage of the counter. U9 is a dual JK flip-flop. U1F, U8C, U18B, U10B, and U10D form the logic to control the states of U9. During an up count, U9 will clock from 0 to 2 and then back to 0 again. Down counting will produce states in the opposite direction. U11, U10C, and U10A form the logic to preset U9. With the remote frequency load line low, the outputs of U11 will all be low, having no effect on U9. If the load line is high, U9A will reset if the 2^0 of 10^7 input is high and clear if it is low; U9B will reset if 2^1 of 10^7 is high and clear if it is low. U8A, U8B, and U8D are used to gate the carry outputs of the first three stages to be used for the tuning resolution select. The tuning resolution switches provide a short to the step select switch output (normally low) for the activated switch and an open circuit for the switches not chosen. Resistors R5 to R8 are pull-up resistors to provide a high level on the open circuited lines. If the 10^1 switch is selected, counter U2 will be enabled. Since the other lines will all be high, all AND gates will be enabled. The resultant is a normal seven decade counter. If the 10^2 step select is chosen, AND gate U8D will be disabled. U2 will be inhibited since its carry input will be high. Since the carry input of U3 is now always low, it will clock for each pulse received on its clock input. U8B and U8A will still be enabled allowing for normal carry operation. The counter now behaves as though counter U2 is no longer in the circuit. If the 10^3 select is chosen, both U2 and U3 are disabled; if the 10^4 is chosen, U2, U3, and U4 are disabled.

The clock and direction signals are from the Manual Tuning Module. When up counting is desired, the clock line lags the direction line by 90°; when down counting is desired, it leads by 90°. U1A and U1E are Schmitt triggers to buffer the input signals. Since both clock and direction lines are inverted, the relative sense between the two signals is maintained. During up counting, the rising edge of the clock will always occur when the direction line is high, causing the counter to increment. In down counting, the rising edge will always occur when the direction line is low, decrementing the counter.

The P inputs of the counters are connected to the Remote Input Jack, J1. When the remote frequency load line is pulsed high, the levels on the P lines will be transferred to the outputs of the counter. If the load line returns low the counter will resume clocking from the new data. The Remote Input Jack also contains lines from the IF bandwidth select circuitry. This allows remote control/monitor of the IF BW.

The RF frequency information is sent to the 1st and 2nd LO Synthesizers via the I/O and Synthesizer Motherboards. It is also sent to multiplexers U12 to U15. U12 receives the 2^0 bit of each digit, U13 receives the 2^1 bit, U19 received the 2^2 bit, and U15 receives the 2^3 bit. The control inputs out U12 to U15 are all tied in parallel and feed to a binary counter U16. This counter is continuously clocked from an oscillator formed by U1C, U1B, C2, and R14. The frequency of oscillation is approximately 2.3 kHz. The outputs of U16 are also sent to J2 for decoding on the display board. The outputs of U12 to U15 are buffered by U17.

Operation of the data selector is as follows: when the counter U16 has all zeros on its outputs, the A, B, and C inputs of U12 to U15 will be low. This will gate all X_0 inputs to their respective Z outputs. The information sent to the display board via J2 will be:

$$\text{If } Q_2\, Q_1\, Q_0 = 000, \text{ then:}$$

$$2^3\ 2^2\ 2^1\ 2^0 = 10^1 \text{ Digit}$$

When the oscillator clocks U16 again, the outputs will become 001. This will cause the X_1 input of each multiplexer to appear at its respective Z output. As the counter U16 clocks, all X inputs will be sent to the Z output in the code shown in Table 3-10.

Table 3-10. Data Selector 14512, Digit Control Codes

Q_2	Q_1	Q_0	$2^3\ 2^2\ 2^1\ 2^0$
0	0	0	10^1 Digit
0	0	1	10^2 Digit
0	1	0	10^3 Digit
0	1	1	10^4 Digit
1	0	0	10^5 Digit
1	0	1	10^6 Digit
1	1	0	10^7 Digit
1	1	1	All Low

This information can now be decoded on the display board. The display board determines which digit is present on the 2^3, 2^2, 2^1, and 2^0 lines by decoding the Q_2, Q_1, and Q_0 inputs.

During power down, the RF frequency is remembered by powering the Up/Down Counter from BT1 (2.5 V). Diode CR1 is used to charge the Nicad battery when power is on and to isolate the battery from the rest of the receiver when power is down. It is a hot carrier diode, dropping only about 0.4 V when forward biased. When power is on, V_{DD} is at 5 V, forward biasing the diode and charging the battery through R9. If power fails, V_{DD} drops to 0 V and diode CR1 becomes reverse biased, allowing battery current to flow only to the chips connected to V_{DD2}.

The purpose of Q1 and its circuitry is to inhibit all counters when power down occurs. Without it, the counters could clock when power was again applied to the encoder assembly, because the clock input could go from a low (during power down) to a high (during power up).

Transistor Q1 controls the step select switch ground. When power is on, the 10 V across voltage divider R11 and R12 will turn Q1 on, which will place a low on the step select common. If the 10 V line drops below 7 V, the base of Q1 will drop below 0.7 V, and the transistor will turn off placing a high on the step select common through resistor R10. This high will prevent any of the step select lines from going low. The step select button chosen will short to a high level now, not a low, and the unchosen switches will still be pulled high by resistors R5 through R8.

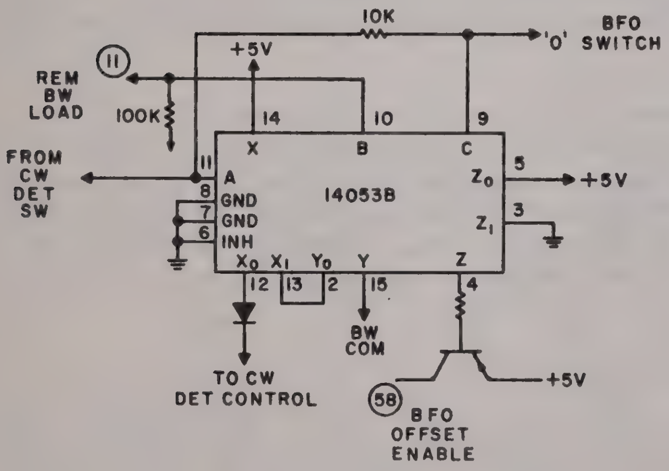
3.4.2 TYPE 791828 FRONT PANEL INTERCONNECT (A6A2)

The purpose of this module is to translate information from the manually controlled front panel into control information for the receiver. The front panel information entering this module controls detection mode, gain mode, meter mode, and IF bandwidth, in addition to headphone and RF gain levels. This information is then decoded, for use primarily in the IF stages of the receiver. Two output lines from the Front Panel Interconnect, however, control the BFO. The schematic diagram for this module is contained in the main chassis schematic diagram, Figure 6-~~20~~.23

This circuit description will explain the operation of each manually controlled input to this module and how it decodes and sends the information to the IF and BFO circuits. The Front Panel Interconnect board incorporates an integrated circuit, U1, which will be discussed below.

As can be seen from the schematic diagram, most of the lines from the front panel are simply passed through to the rest of the receiver. For these lines, this module serves as a patch panel. For the IF bandwidth lines and certain detection mode lines, diode logic is performed by CR1-3 and CR5-10 to control the combinations of IF filters, as described in paragraph 3.2.1.

The truth table for analog multiplexer U1 is shown in Figure 3-24. This IC performs as three digitally controlled SPDT switches. When control input A is logic low, terminals X and X_0 are internally connected. When A is logic high, X and X_1 are connected. Similarly, input B controls Y, Y_0, and Y_1 and input C controls Z, Z_0, and Z_1. This circuit performs most of the logic functions associated with the front panel pushbuttons for detection mode (on A10A1) and IF bandwidth (on A10A2). Refer to Figure 6-23 for the following descriptions. Notice that both A10A1 and A10A2 have their own set of "E" terminals to A10P1, using some of the same numbers.



CONTROL INPUTS			ON SWITCHES		
C	B	A			
0	0	0	Z_0	Y_0	X_0
0	0	1	Z_0	Y_0	X_1
0	1	0	Z_0	Y_1	X_0
0	1	1	Z_0	Y_1	X_1
1	0	0	Z_1	Y_0	X_0
1	0	1	Z_1	Y_0	X_1
1	1	1	Z_1	Y_1	X_0
1	1	1	Z_1	Y_1	X_1

Figure 3-24. Front Panel Interconnect Integrated Circuit Data

When CW mode is selected, the detection mode switch connects E4 to E12, and E5 to E6. This places +5 V on the CW select line to IF Motherboard A4. Input B of U1 is controlled by the remote bandwidth control line entering at XA2 pin 11. Since this line is logic low in local mode, U1 input B is normally low, and Y is connected to Y . Therefore, when E5 is connected to E6, the +5 V at U1 input A causes the +5 V line at X to be connected through X1, Y , and Y, to E19 and the IF bandwidth switch common line, enabling these switches. Therefore, any bandwidth may be selected in CW mode. If "0" is selected on the "+, 0 ,-" BFO switch, the switch common (ground) places a low on U1 input C, Z and Z are connected, Q1 is turned off, and the resulting low voltage at XA2 pin 58 causes the BFO preset lines to be pulled low, producing a fixed 455 kHz BFO frequency. (Refer to 3.3.5 for a description of the BFO presets.) If "+" or "-" is selected, the ground is removed and U1 input C is pulled high by R7, Q1 is turned on and power is applied to the BFO preset pull-up resistors, entering whatever frequency code is present at the BFO Switch. Therefore, the BFO may be either fixed or variable in the CW mode.

When AM mode is selected, the detection mode switch connects E4 to E16, and E5 and E14 to E6. This places +5 V on the AM select line (to A4) and allows +5 V on the bandwidth switch common line, enabling these switches. This also places +5 V on XA2 pin 60, which inhibits BFO operation.

When FM mode is selected, the detection mode switch connects E4 to E15, and E5 and E14 to E6. This places +5 V on the FM select line (to A4), enables the bandwidth switches and inhibits the BFO, as previously described.

When USB mode is selected, the detection mode switch connects E4 to E8 and grounds E5 and E14. This places +5 V on the USB select line (to A4) and places a low at U1 input A. This disables the IF bandwidth switches and turns off Q1, fixing the BFO at 455 kHz, as previously described.

When LSB mode is selected, the detection mode switch connects E4 to E7 and grounds E5 and E14. This places +5 V on the LSB select line, disables the IF bandwidth switches and fixes the BFO at 455 kHz.

When ISB mode is selected, the detection mode switch connects E4 to E11, E9 to E10, and opens the normal connection between E10 and E13. Connecting E4 to E11 places +5 V on the ISB select line to A4. In all other modes, the combined audio line is supplied to both audio amplifiers on A10A2, via E9 and E3. In ISB mode, the combined audio line to A10A2E9 is replaced by the ISB/LSB audio line, via the E9-E10 connection. Therefore, the USB audio is supplied to A10A2 headphone amplifier U1A via the combined audio line, and the LSB audio is supplied to amplifier U1B.

3.4.3 TYPE 791874-1 MANUAL TUNING MODULE (A7)

The Manual Tuning Module controls the direction and rate of change of the tuned frequency. This module connects to the Manual Tuning Up/Down Counter (A6A1) and is mounted behind the receiver's front panel. The Manual Tuning Module consists of two parts: the encoder assembly and the Tuning Resolution switches. The schematic diagram of this module can be found in Figure 6-21.

3.4.4 TYPE 791589 TUNING RESOLUTION (A7A1)

The Tuning Resolution switches select the desired tuning step to be used. The tuning steps are: 10 Hz, 100 Hz, 1 kHz, and 10 kHz. Switching is accomplished by connecting the desired tuning step to the step select switch line (+5 V) of the Manual Tuning Up/Down Counter board (A6A1). The schematic diagram for this circuit is shown in Figure 6-21.

When the 10 Hz button is depressed, E2 (10 Hz step line) connects to E16 (+5 V) and all digits are available for tuning. When the 100 Hz button is depressed, E10 (the 100 Hz step line) connects to E16 (+5 V). The 10 Hz digit is locked to the frequency indicated when the 100 Hz button was engaged, while all other digits are available for tuning. When the 1 kHz button is depressed, E12 connects to E16, thus the five most significant digits of the readout can be varied by the tuning knob. The two least significant digits will be locked to the frequency indicated when this button is engaged. When the 10 kHz button is selected, E8 connects to E16 and only the four most-significant digits of the readout can be varied by the tuning knob. The 1 kHz, 100 Hz, and 10 Hz digits will be locked to the frequency indicated when the 10 kHz button is engaged.

When the tuning disable button is engaged, the receiver locks to the frequency currently being displayed, any other tuning button will be released, and manual tuning is disabled. In receivers with the MCM-2 remote control option, depressing the tuning button enables remote control operation.

3.4.5 ENCODER ASSEMBLY (A7U1)

This assembly converts tuning knob rotation to digital pulses for the Manual Tuning Up/Down Counter. When the tuning knob is turned, each of the two output lines from the encoder will swing repeatedly between approximately +5 V and 0 V. If the knob is rotated at constant speed, these two outputs will appear as trains of square waves. Due to the internal mechanics of the encoder, the transitions of these two-wave trains will be staggered in time with respect to each other. When the knob is rotated clockwise to increase tuned frequency, the square wave on the direction line will appear to lead that on the clock line as in Figure 3-25. The action of the up/down counter depends on the level of its up/down input at the instant its clock line goes high. The level of the up/down input at any other time has no effect. Therefore, clockwise rotation causes the counter to count up and the tuned frequency to increase.

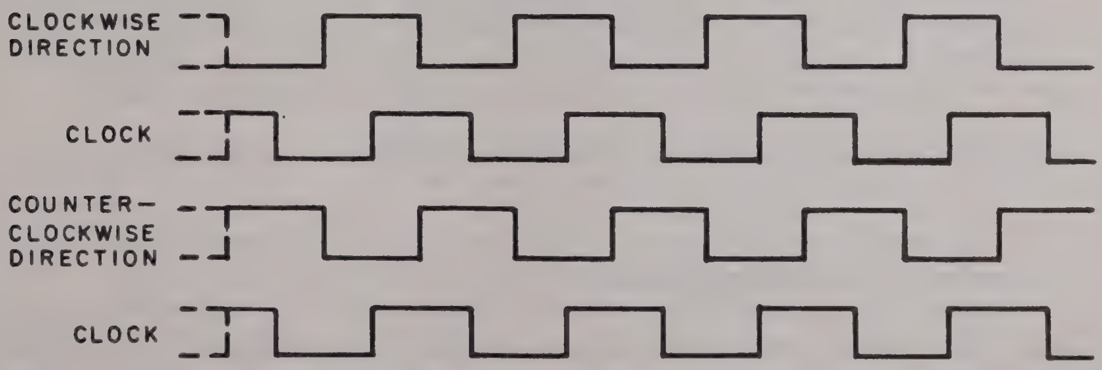


Figure 3-25. Encoder Assembly Timing Diagram

If the tuning knob is rotated counterclockwise, the sequence of outputs is reversed; the direction square wave lags the clock square wave. In this case the direction line will be low when the clock line swings high causing the counter to count down, thus reducing the tuned frequency.

The two outputs of the encoder go through approximately 120 cycles per revolution of its input shaft. This causes a tuning step for roughly each 3_0 of knob rotation.

The encoder assembly uses infrared optics to accomplish its internal functions. It is not considered a repairable assembly.

3.4.6 TYPE 791578 FREQUENCY DISPLAY (A8)

The Frequency Display accepts the multiplexed information from the Manual Tuning Up/Down Counter via connector J2 and displays it on seven LED's on the front panel. The schematic diagram for this circuit is shown in Figure 6-20.

U1 to U7 are the seven segment common-cathode LED displays. All segments of each display are connected in parallel to the corresponding outputs of U8, a BCD to seven-segment decoder/driver. U8 accepts a BCD word on its A, B, C and D inputs, converts it to a seven-segment equivalent, and places the information on its a to g outputs. The outputs are internally current limited to provide about 50 mA so that external resistors are not needed. To turn a particular digit on, its common cathode input must be logic low. This selection is provided by U9, a binary to octal decoder. It accepts the Q0 to Q2 data on its A, B, and C inputs and places a high on the Q output with the equivalent binary value. U10 is an eight-section buffer inverter, capable of providing up to 500 mA of sink current.

Operation of the circuit is described below. The Up/Down Counter places digit display information into the A, B, and C inputs of U9. BCD information enters the A, B, C and D lines of U8. In U8, this information is decoded into a seven-segment number and sent to all the LED's. U9 enables only one display at a time as commanded by its input information. Since the rate of change is 2 kHz, each digit is refreshed every 4 msec (2 kHz/8). This flicker rate is undetectable by the human eye.

Transistor Q1 is used for the intensity control. It is connected as a pass transistor from the unregulated 10 V to the supply voltage of U8. As the supply voltage of U8 is increased the current delivered to the LEDs will increase, giving more intensity. R1, R2, and R4 are a voltage divider which bounds the emitter voltage of Q1 between about 4.5 V and 7 V.

The decimal point, CR1, is always on, receiving its current from Q1 through resistor R3.

3.4.7 TYPE 791588 BFO SWITCH (A9)

The BFO Switch schematic diagram can be found in Figure 6-21. Three thumbwheel switches provide a BFO variation of ±8.9 kHz from 455 kHz. The +, 0, -, thumbwheel provides the direction of offset, the second thumbwheel varies in range from 0 to 8, and the third thumbwheel varies in range from 0 to 9. A '0' setting of the direction thumbwheel causes the BFO to return automatically to 455 kHz (regardless of the other thumbwheel settings). The truth table for these switches is given in Table 3-11.

Table 3-11. BFO Switch Truth Tables

NUMERIC DIGIT	OUTPUT 2^3	2^2	2^1	2^0
0	X	X	X	X
1	X	X	X	O
2	X	X	O	X
3	X	X	O	O
4	X	O	X	X
5	X	O	X	O
6	X	O	O	X
7	X	O	O	O
8	O	X	X	X
9	O	X	X	O

SIGN DIGIT	OUTPUT + 0 -
+	X O O
O	X X O
-	O O X

X denotes shorted to common
O denotes open

3.4.8 TYPE 791684 FRONT PANEL CONTROL (A10)

The Front Panel Control consists of the Upper and Lower Panel Control boards joined by a 40-pin ribbon connector. This connector is attached to the Front Panel Interconnect (A6A2) and controls the manual selection of detection mode, gain mode, meter mode, IF bandwidth, RF gain, and headphone levels. Signals for the phone outputs also connect to the lower panel control through the Front Panel Interconnect. The functions of the IF bandwidth and detection mode switches are described in paragraph 3.4.2.

3.4.9 TYPE 791583 UPPER PANEL CONTROL (A10A1)

The Upper Panel Control allows selection of detection mode, gain mode, and meter mode. Each gang of switches mechanically operates to allow only one pushbutton to be depressed at any time. All control lines connect to the Front Panel Interconnect card. The schematic diagram for this circuit is shown in Figure 6-~~20~~.21

3.4.10 TYPE 791826 LOWER PANEL CONTROL (A10A2)

The Lower Panel Control allows selection of IF bandwidth and variation of RF gain and phone level potentiometers. The schematic diagram for this circuit is Figure 6-~~20~~21 This card also contains the amplifiers to drive the headphone outputs. The amplifiers operate independently. They receive the same signal in all detection modes except ISB. In this mode, amplifier U1A receives the upper sideband information while U1B receives the lower sideband information. No damage will be done to the amplifiers when using mono headphones; however, LSB in the ISB mode will not be monitored.

3.5 POWER SUPPLY SECTION

Refer to the main chassis schematic diagram, Figure 6-22. The Power Supply section is shown in the left-hand side of the schematic. The receiver may be operated from either 110 Vac ±15% or 220 Vac ±15%. This voltage feeds to Filter Assembly FL1 which contains fuse F1, input voltage selection, and initial filtering. The receiver power switch, S1, is connected in series with one side of the ac line. The output of the voltage-select pc wafer connects through the Power Distribution board to transformer T1. This transformer has a dual primary and center-tapped secondaries, with 34 Vac across pins 9 to 11 and 16 Vac across pins 6 to 8. Both potentials enter Power Distribution board A1.

3.5.1 TYPE 76240 POWER DISTRIBUTION (A1)

The Power Distribution board receives 34 Vac and 16 Vac for inputs, and rectifies these voltages for various circuits and regulators in the receiver. The 34 Vac enters this board and is full-wave rectified by A1CR1, CR2, CR3, and CR4. The voltage is then filtered by A1C1 and A1C2 and sent to regulators U1 and U2. The 16 Vac is rectified by CR1 and CR2, which are located on the back of the chassis, and returned to the Distribution board to be filtered by A1C3 and A1C4 to become a +10 V unregulated supply.

3.5.2 POWER SUPPLY REGULATORS

U1 and U2 are located on the back of the chassis and provide regulated +15 Vdc and -15 Vdc, respectively. These two voltages are supplied to most of the circuits in the receiver. The unregulated 10 Vdc, with its unregulated ground, connects to U3, a +5 Vdc regulator. U3 supplies +5 Vdc to the BFO and 2nd LO Synthesizers, the Up/Down Counter board, and the Front Panel Interconnect card. The unregulated 10 Vdc also connects to A5U1 and A5U2, which are +5 Vdc regulators for the 1st and 3rd LO Synthesizers. The regulators all have internal protection from thermal and current overload. U1 and U2, on the rear panel, will automatically shut down when current exceeds 1 amp. Similarly, U3 on the rear panel will shut down when current exceeds 3 amps.

SECTION IV

MAINTENANCE

4.1 GENERAL

This section provides detailed procedures to perform operative and corrective maintenance on the WJ-8718 HF Receiver. The maintenance areas covered by the given procedures include: cleaning, lubrication, inspection for damage or wear, overall receiver performance, modular and component level troubleshooting, and modular adjustment and/or alignment. Performance tests and troubleshooting procedures are sufficient to allow fault isolation to the component level. Optimum receiver performance can be effectively maintained by conducting the given procedures on a routine basis. A recommended Periodic Maintenance Schedule is shown in Table 4-1.

Table 4-1. Periodic Maintenance Schedule

Procedure	Interval	Comments
Cleaning	60 days	Interval variable depending on on operating environment.
Lubrication	30 days	Interval variable depending on equipment use.
Inspection for Damage or Wear	60 days	Interval variable depending on operating environment and equipment use.
Performance Tests	180 days	Interval variable depending on operating environment and equipment use.
Adjustment/Alignment	--	Adjustment/Alignment keyed to results of Performance Tests.

4.2 CLEANING AND LUBRICATION

4.2.1 CLEANING

Cleaning should be performed to remove accumulated dust, grease, and other contamination, and to ensure trouble-free operation.

CAUTION

Avoid the use of chemical cleaning agents containing benzene, toluene, zylene, acetone, or similar solvents. These chemicals may damage the plastics used in this receiver.

1. Exterior - Dust the cabinet off with a soft cloth. Dust the front panel controls with a small soft-bristled paint brush. Dirt clinging to the cabinet may be removed with a clean, lint-free cloth dampened with a mild detergent and water solution. Avoid using abrasive cleaners. They will scratch the front panel.

2. Interior - Dust in the interior of the unit should be removed before it builds up enough to cause arcing and short circuits during periods of high humidity. Dust is best removed by dry, low-pressure air. Dirt clinging to surfaces may be removed with a soft-bristled paint brush or a clean, lint-free cloth dampened with a mild detergent and water solution. Use a cotton-tipped applicator for cleaning in narrow spaces and on the circuit boards.

3. Switch Contacts - When maintenance is necessary due to accumulated dirt and dust on the contacts, observe the following precautions: Clean the switch contacts with isopropyl alcohol or a mild detergent solution. Avoid cleaning solutions containing benzene, acetone, or similar solvents.

4.2.2 LUBRICATION

The optical encoder assembly shaft requires periodic lubrication to prevent excessive wear. The other rotating assemblies in the receiver are sealed and do not require lubrication. To lubricate the encoder assembly shaft, perform the following steps:

CAUTION

Excessive lubrication of the encoder shaft may destroy the optical characteristics of the encoder wheel.

1. Place the receiver in a vertical position and remove the encoder knob.

2. Apply one (1) drop of SAE 5W-20W oil to the encoder shaft at the retaining ring.

3. Reassemble the encoder assembly knob and rotate the knob several times to distribute the lubricant.

4.3 INSPECTION FOR DAMAGE OR WEAR

Many potential or existing faults can be detected by making a visual inspection of the unit. For this reason, a complete visual inspection should be made on a routine basis and whenever the receiver is inoperative. At a minimum, the following items should be visually inspected.

1. Inspect the equipment covers and front panel for condition of finish and panel markings.
2. Inspect for dents, punctures, or warped areas.
3. Inspect quarter-turn fasteners and receptacles.
4. Inspect the external surfaces for loose or missing screws or washers.
5. Inspect the receptacles for conditions of pins, contacts, and mountings.
6. Inspect the internal components for signs of deterioration, discoloration, or charring. Check for melted insulation and damaged, cracked, or broken components.
7. Inspect the printed circuit boards for damaged tracks, loose connections, corrosion, or other signs of deterioration.
8. Inspect the PC connectors, interface connectors, and chassis wiring for excessive wear, looseness, misalignment, corrosion, or other signs of deterioration.

4.4 TEST EQUIPMENT REQUIRED

The test equipment listed in Table 4-2 or their equivalents are required to perform the given maintenance procedures. All the equipment, however, is not used for any one procedure.

4.5 CORRECTIVE MAINTENANCE INFORMATION

4.5.1 GENERAL

Corrective Maintenance procedures include the testing, troubleshooting, repair and alignment information necessary to return a defective receiver to a serviceable condition. Information is contained in this paragraph to:

1. Troubleshoot the receiver to a replaceable PC board.
2. Replace identified faulty PC boards.

Individual PC board testing and repair procedures are contained in paragraph 4.7. Receiver alignment procedures are contained in paragraph 4.8.

A receiver will require corrective maintenance action for one of the following reasons:

1. Failure to pass any initial inspection testing.
2. Failure to meet the minimum performance standards in Table 4-3 as a result of Performance Testing (paragraph 4.6) under a preventive maintenance schedule.
3. Operator-observed malfunctions during normal operation of the receiver.

Table 4-2. Test Equipment Required

Instrument Type	Required Characteristics	Recommended Instrument
Signal Generator	AM, FM, CW, RF output, from -111 dBm to 0 dBm	HP8640B
Oscilloscope	dc to 50 MHz	HP180C
RF Voltmeter	1 mV to 3.0 V; -50 dBm to +20 dBm	Boonton 92B
Variable Transformer	Metered output, from 90-115 Vac	General Radio W5MT3A
Variable Transformer	Output variable from 180-220 Vac	General Radio W5HMT
Digital Counter	0 to 500 MHz	HP5303A
AC Voltmeter	1 mV to 300 V, full scale	HP-400E
DVM	dc ranges; 1% or better	Fluke 8100A
Dummy Load, 600 Ω	4-W dissipation	Two 1200 Ω, 2-W resistors in parallel
Dummy load, 600 Ω	1/2-W dissipation	Two 1200 Ω, 1/4 - or 1/2-W resistors in parallel
Headphones	Stereo, 600 Ω impedance, or: Mono, 600 Ω impedance	Telex 325-02 Telex 820-4
Sweep Generator	100 kHz to 11.0 MHz	HP8601A

4.5.2 PROCEDURE GUIDELINES

To troubleshoot a defective receiver, refer to the Corrective Maintenance Flowchart, Figure 4-1, and proceed as follows:

1. If fault symptoms are known, refer to the Operationally Based Fault Symptoms at the beginning of the flowchart. This will direct the technician to those specific procedures required to localize the fault.
2. If fault symptoms are unknown, begin at START and proceed horizontally through the flowchart. Perform the indicated Performance Tests until a fault (NO) is encountered.
3. Localize the fault to a defective PC board by proceeding vertically through the Modular-Level Troubleshooting Paths and conducting the indicated tests.
4. Replace the defective PC board and perform any required adjustments and/or alignments to the new PC board. Refer to the Adjustment/Alignment Procedures given in 4.8 to find the relevant procedure.
5. Steps for isolating a fault to a particular component within a defective PC board are provided by the Component Level Troubleshooting procedures given in 4.7.
6. After PC board replacement, verify receiver operation by conducting the Performance Tests in 4.6. Receivers should not be acceptable for use unless all Minimum Performance Standards listed in Table 4-3 are met or exceeded.

4.6 PERFORMANCE TESTS

4.6.1 GENERAL

The Performance Tests determine if the receiver operates in all detection modes, gain modes, and IF bandwidths. The given tests should be used for initial inspection, periodic operational checks, or to confirm performance standards after repairs have been made. Only skilled maintenance technicians using the test equipment listed in Table 4-2 should carry out the Performance Tests. If a receiver fault is encountered as a result of conducting the given tests, refer to the Corrective Maintenance Flowchart, Figure 4-1, for aid in isolating the fault.

4.6.2 MINIMUM PERFORMANCE STANDARDS

Table 4-3 summarizes the parameters tested by the Performance Tests. To be acceptable for use, the receiver should meet or exceed all minimum performance standards listed.

Table 4-3. Receiver Minimum Performance Standards

Parameter to be Tested	Performance Standard
Receiver Gain, Input to IF Out	82 dB ±2 dB on all bandwidths
S/N Ratio, Input to IF Out	10 dB with -103 dBm input level and 6 kHz bandwidth
AM Detection Mode, Input to Phone Out	Audibility in headphones with -97 dBm input and 50% modulation
Line Audio Out in AM Mode	2 W into 600 Ω with -97 dBm input and 50% modulation.
CW Detection Mode, Input to Phone Out	Audibility in headphone with -97 dBm unmodulated input
FM Detection Mode, Input to Phone Out	Audibility in headphones with -97 dBm input and 4.8 kHz deviation
USB, LSB, and ISB Detection Modes, Input to Phone Out	Audibility in headphones with -97 dBm unmodulated input
Manual Gain Control	100 dB control range
AGC Performance	Control range -97 dBm to +3 dBm with < 6 dB output change
Frequency Tuning Accuracy	±100 Hz at 500 kHz and 29.99999 MHz

4.6.3 PROCEDURE GUIDELINES

When conducting the Peformance Tests, the technician should comply with the following guidelines:

1. Read each paragraph and test procedure carefully before attempting to perform the test.
2. All tests are to be performed under the following environmental conditions unless otherwise specified:

    Temperature: $+25^{\circ}$ C $\pm 5^{\circ}$ C ($+77^{\circ}$ F $\pm 9^{\circ}$ F)
    Altitude: Room ambient
    Humidity: Room ambient

3. Allow a minimum of 30 minutes warm-up time for test equipment prior to performing any of the tests.
4. All inputs to and outputs from the equipment under test which are not used during a particular test are to be terminated with their characteristic impedances.

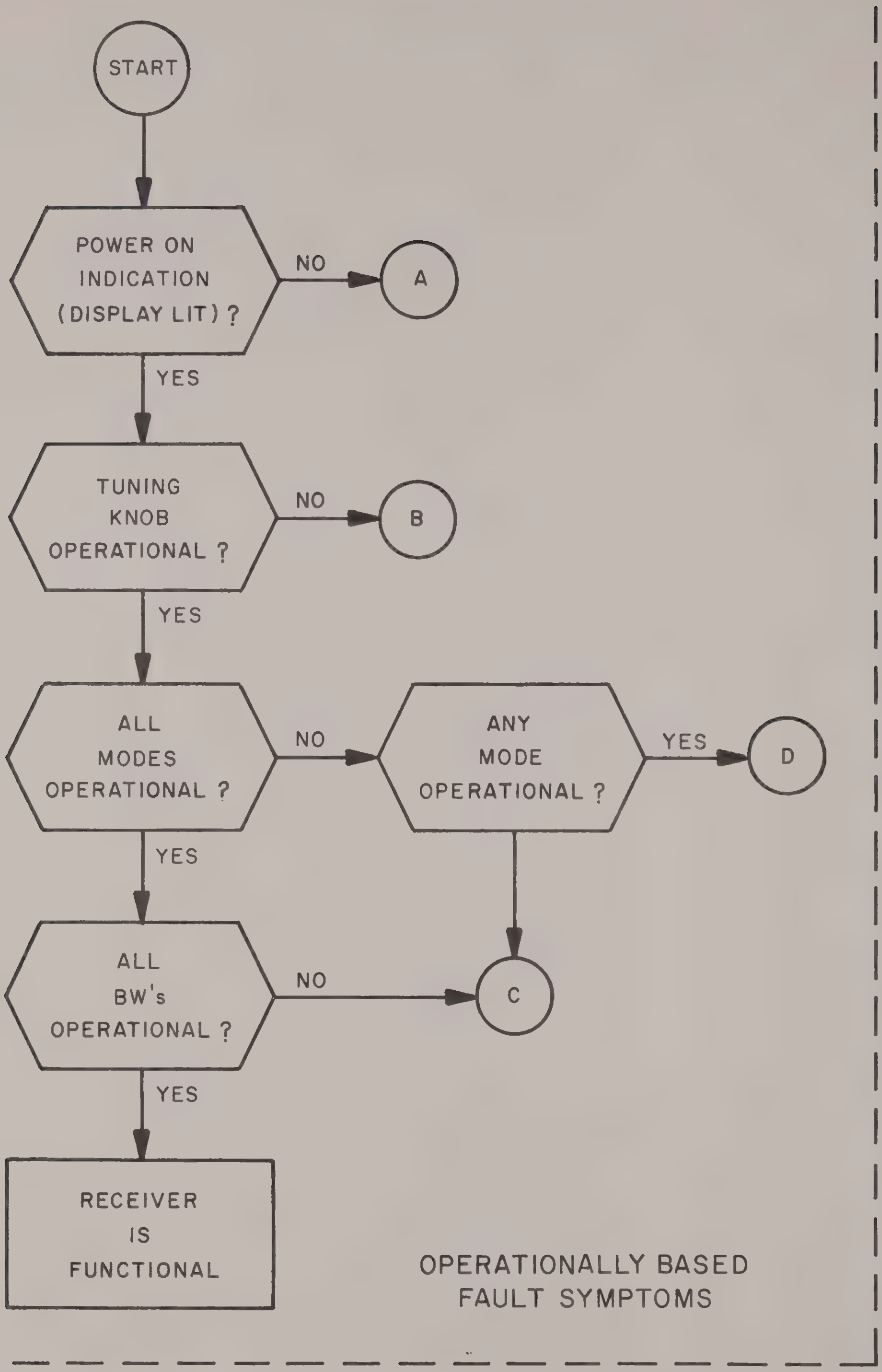


Figure 4-1a. Corrective Maintenance Flowchart

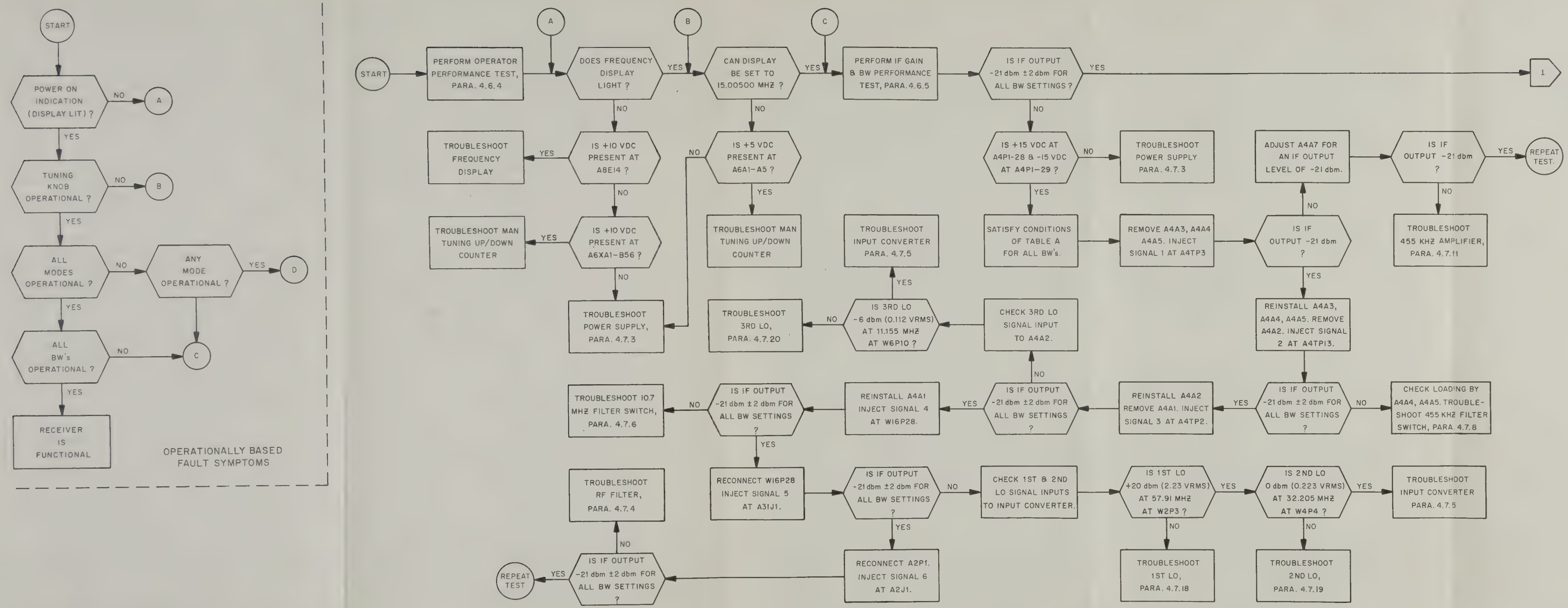

START
POWER ON INDICATION (DISPLAY LIT) ?
NO
A
YES
TUNING KNOB OPERATIONAL ?
NO
B
YES
ALL MODES OPERATIONAL ?
NO
ANY MODE OPERATIONAL ?
YES
D
YES
ALL BW's OPERATIONAL ?
NO
C
YES
RECEIVER IS FUNCTIONAL
OPERATIONALLY BASED FAULT SYMPTOMS
START
PERFORM OPERATOR PERFORMANCE TEST, PARA. 4.6.4
A
DOES FREQUENCY DISPLAY LIGHT ?
YES
B
CAN DISPLAY BE SET TO 15.00500 MHZ ?
YES
C
PERFORM IF GAIN & BW PERFORMANCE TEST, PARA. 4.6.5
IS IF OUTPUT -21 dbm ±2 dbm FOR ALL BW SETTINGS ?
YES
1
NO
IS +10 VDC PRESENT AT A8E14 ?
YES
TROUBLESHOOT FREQUENCY DISPLAY
NO
IS +10 VDC PRESENT AT A6XA1-B56 ?
YES
TROUBLESHOOT MAN TUNING UP/DOWN COUNTER
NO
TROUBLESHOOT POWER SUPPLY, PARA. 4.7.3
NO
IS +5 VDC PRESENT AT A6A1–A5 ?
NO
YES
TROUBLESHOOT MAN TUNING UP/DOWN COUNTER
NO
IS +15 VDC AT A4P1-28 & -15 VDC AT A4P1–29 ?
NO
TROUBLESHOOT POWER SUPPLY PARA. 4.7.3
YES
SATISFY CONDITIONS OF TABLE A FOR ALL BW's.
REMOVE A4A3, A4A4 A4A5. INJECT SIGNAL 1 AT A4TP3
IS IF OUTPUT -21 dbm ?
NO
ADJUST A4A7 FOR AN IF OUTPUT LEVEL OF -21 dbm.
IS IF OUTPUT -21 dbm ?
YES
REPEAT TEST.
NO
TROUBLESHOOT 455 KHZ AMPLIFIER, PARA. 4.7.11
YES
REINSTALL A4A3, A4A4, A4A5. REMOVE A4A2. INJECT SIGNAL 2 AT A4TP13.
IS IF OUTPUT -21 dbm ±2 dbm FOR ALL BW SETTINGS ?
NO
CHECK LOADING BY A4A4, A4A5. TROUBLESHOOT 455 KHZ FILTER SWITCH, PARA. 4.7.8
YES
REINSTALL A4A2 REMOVE A4A1. INJECT SIGNAL 3 AT A4TP2.
IS IF OUTPUT -21 dbm ±2 dbm FOR ALL BW SETTINGS ?
NO
CHECK 3RD LO SIGNAL INPUT TO A4A2.
IS 3RD LO -6 dbm (0.112 VRMS) AT 11.155 MHZ AT W6P10 ?
YES
TROUBLESHOOT INPUT CONVERTER PARA. 4.7.5
NO
TROUBLESHOOT 3RD LO, PARA. 4.7.20
YES
REINSTALL A4A1 INJECT SIGNAL 4 AT W16P28.
IS IF OUTPUT -21 dbm ±2 dbm FOR ALL BW SETTINGS ?
NO
TROUBLESHOOT 10.7 MHZ FILTER SWITCH, PARA. 4.7.6
YES
RECONNECT W16P28 INJECT SIGNAL 5 AT A31J1.
IS IF OUTPUT -21 dbm ±2 dbm FOR ALL BW SETTINGS ?
NO
CHECK 1ST & 2ND LO SIGNAL INPUTS TO INPUT CONVERTER.
IS 1ST LO +20 dbm (2.23 VRMS) AT 57.91 MHZ AT W2P3 ?
NO
TROUBLESHOOT 1ST LO, PARA. 4.7.18
YES
IS 2ND LO 0 dbm (0.223 VRMS) AT 32.205 MHZ AT W4P4 ?
NO
TROUBLESHOOT 2ND LO, PARA. 4.7.19
YES
TROUBLESHOOT INPUT CONVERTER PARA. 4.7.5
YES
RECONNECT A2P1. INJECT SIGNAL 6 AT A2J1.
IS IF OUTPUT -21 dbm ±2 dbm FOR ALL BW SETTINGS ?
NO
TROUBLESHOOT RF FILTER, PARA. 4.7.4
YES
REPEAT TEST

TABLE A BW SWITCHING VOLTAGE

PIN	16 KHZ	6 KHZ	3 KHZ	1 KHZ	.3 KHZ
A1-15	+5	0	0	0	0
A1-17	0	+5	0	0	0
A1-19	0	0	+5	+5	+5
A3-15	+5	+5	+5	0	0
A3-17	0	0	0	+5	0
A3-19	0	0	0	0	+5

NOTE: TO RESOLVE INCORRECT VOLTAGE LEVELS, TROUBLESHOOT FRONT PANEL INTERCONNECT OR LOWER PANEL CONTROL.

SIGNALS

SIGNAL 1 455 KHZ UNMOD. AT –75 dbm.
SIGNAL 2 455 KHZ UNMOD. AT – 84 dbm
SIGNAL 3 10.7 MHZ UNMOD. AT – 78 dbm.
SIGNAL 4 15.00500 MHZ UNMOD. AT –92 dbm.
SIGNAL 5 15.00500 MHZ UNMOD. AT –104 dbm
SIGNAL 6 15.00500 MHZ UNMOD. AT –103 dbm

Figure 4-1a. Corrective Maintenance Flowchart

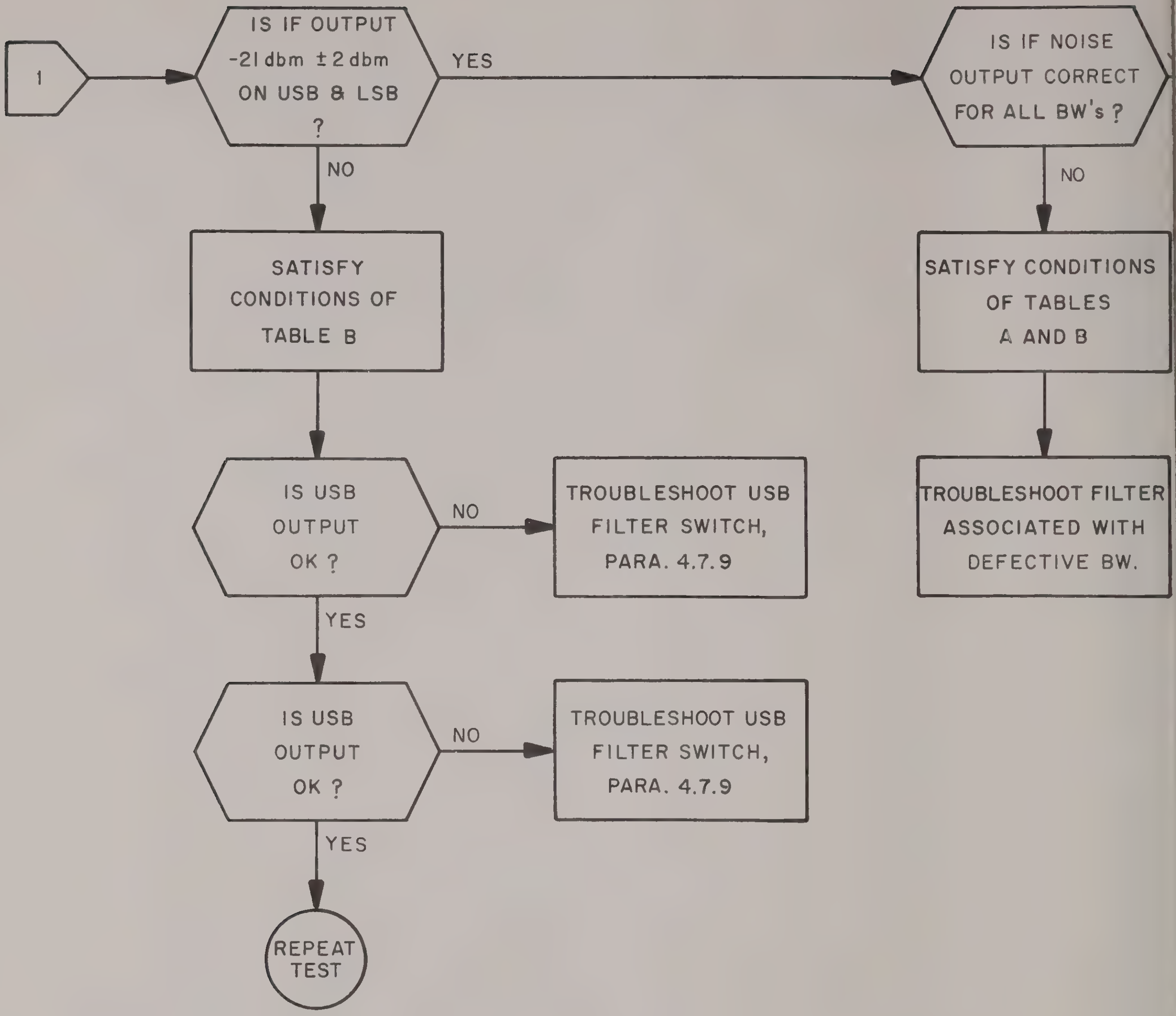

1
IS IF OUTPUT -21 dbm ± 2 dbm ON USB & LSB ?
YES
NO
IS IF NOISE OUTPUT CORRECT FOR ALL BW's ?
NO
SATISFY CONDITIONS OF TABLE B
SATISFY CONDITIONS OF TABLES A AND B
IS USB OUTPUT OK ?
NO
TROUBLESHOOT USB FILTER SWITCH, PARA. 4.7.9
TROUBLESHOOT FILTER ASSOCIATED WITH DEFECTIVE BW.
YES
IS USB OUTPUT OK ?
NO
TROUBLESHOOT USB FILTER SWITCH, PARA. 4.7.9
YES
REPEAT TEST

TABLE B
USB/LSB SWITCHING VOLTAGE

PIN	USB	LSB
A4-49	+5	0
A4-51	0	0
A5-49	0	+5
A5-51	0	+5

NOTE: TO RESOLVE INCORRECT VOLTAGE LEVELS, REFER TO FRONT PANEL INTERFACE TROUBLESHOOTING, PARA.

SIGNALS

SIGNAL	7	400 HZ AT 0.7 VRMS.
SIGNAL	8	400 HZ AT 0.3 mVRS.
SIGNAL	9	455 KHZ UNMOD. AT -28 dbm.

Figure 4-1b. Corrective Maintenance Flowchart

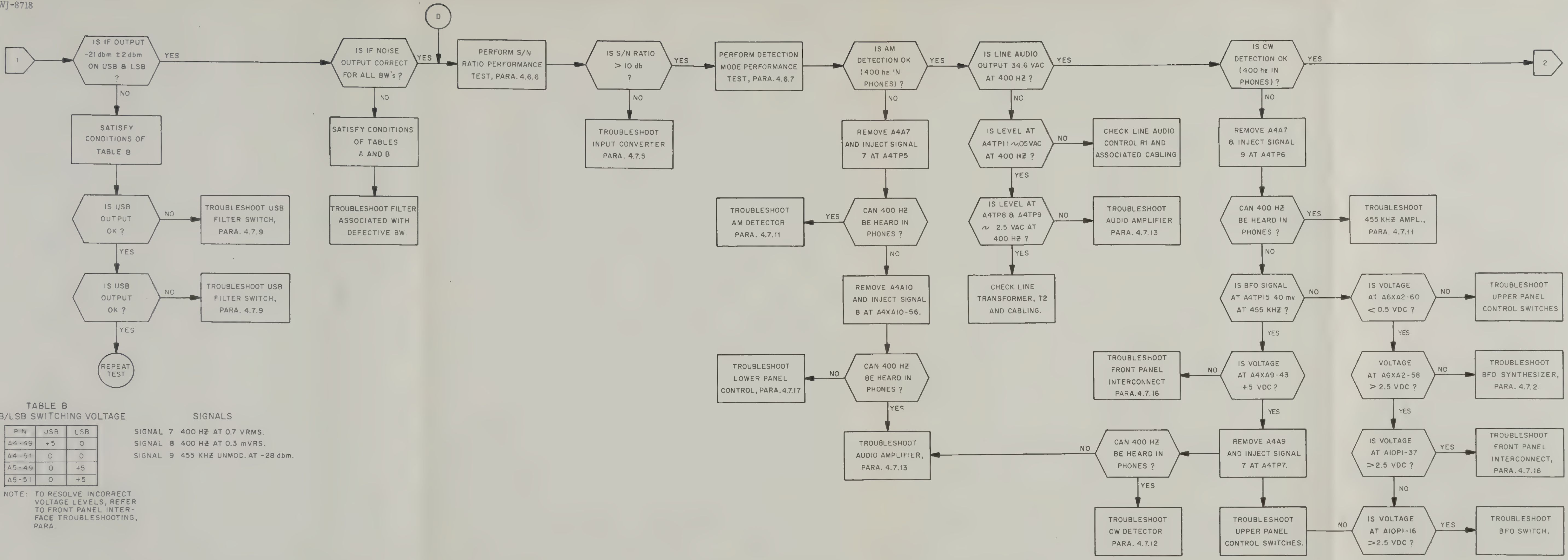

1
IS IF OUTPUT -21 dbm ±2 dbm ON USB & LSB ?
YES
NO
SATISFY CONDITIONS OF TABLE B
IS USB OUTPUT OK ?
NO
TROUBLESHOOT USB FILTER SWITCH, PARA. 4.7.9
YES
IS USB OUTPUT OK ?
NO
TROUBLESHOOT USB FILTER SWITCH, PARA. 4.7.9
YES
REPEAT TEST
D
IS IF NOISE OUTPUT CORRECT FOR ALL BW's ?
YES
NO
SATISFY CONDITIONS OF TABLES A AND B
TROUBLESHOOT FILTER ASSOCIATED WITH DEFECTIVE BW.
PERFORM S/N RATIO PERFORMANCE TEST, PARA. 4.6.6
IS S/N RATIO > 10 db ?
YES
NO
TROUBLESHOOT INPUT CONVERTER PARA. 4.7.5
PERFORM DETECTION MODE PERFORMANCE TEST, PARA. 4.6.7
IS AM DETECTION OK (400 hz IN PHONES) ?
YES
NO
REMOVE A4A7 AND INJECT SIGNAL 7 AT A4TP5
CAN 400 HZ BE HEARD IN PHONES ?
YES
TROUBLESHOOT AM DETECTOR PARA. 4.7.11
NO
REMOVE A4A10 AND INJECT SIGNAL 8 AT A4XA10-56.
CAN 400 HZ BE HEARD IN PHONES ?
NO
TROUBLESHOOT LOWER PANEL CONTROL, PARA. 4.7.17
YES
TROUBLESHOOT AUDIO AMPLIFIER, PARA. 4.7.13
IS LINE AUDIO OUTPUT 34.6 VAC AT 400 HZ ?
YES
NO
IS LEVEL AT A4TP11 ~.05 VAC AT 400 HZ ?
NO
CHECK LINE AUDIO CONTROL R1 AND ASSOCIATED CABLING
YES
IS LEVEL AT A4TP8 & A4TP9 ~ 2.5 VAC AT 400 HZ ?
NO
TROUBLESHOOT AUDIO AMPLIFIER PARA. 4.7.13
YES
CHECK LINE TRANSFORMER, T2 AND CABLING.
IS CW DETECTION OK (400 hz IN PHONES) ?
YES
2
NO
REMOVE A4A7 & INJECT SIGNAL 9 AT A4TP6
CAN 400 HZ BE HEARD IN PHONES ?
YES
TROUBLESHOOT 455 KHZ AMPL., PARA. 4.7.11
NO
IS BFO SIGNAL AT A4TP15 40 mv AT 455 KHZ ?
NO
IS VOLTAGE AT A6XA2-60 < 0.5 VDC ?
NO
TROUBLESHOOT UPPER PANEL CONTROL SWITCHES
YES
VOLTAGE AT A6XA2-58 > 2.5 VDC ?
NO
TROUBLESHOOT BFO SYNTHESIZER, PARA. 4.7.21
YES
IS VOLTAGE AT A10P1-37 >2.5 VDC ?
YES
TROUBLESHOOT FRONT PANEL INTERCONNECT, PARA. 4.7.16
NO
IS VOLTAGE AT A10P1-16 >2.5 VDC ?
YES
TROUBLESHOOT BFO SWITCH.
NO
TROUBLESHOOT UPPER PANEL CONTROL SWITCHES.
YES
IS VOLTAGE AT A4XA9-43 +5 VDC ?
NO
TROUBLESHOOT FRONT PANEL INTERCONNECT PARA. 4.7.16
YES
REMOVE A4A9 AND INJECT SIGNAL 7 AT A4TP7.
CAN 400 HZ BE HEARD IN PHONES ?
NO
YES
TROUBLESHOOT CW DETECTOR PARA. 4.7.12

TABLE B
USB/LSB SWITCHING VOLTAGE

PIN	USB	LSB
A4-49	+5	0
A4-51	0	0
A5-49	0	+5
A5-51	0	+5

NOTE: TO RESOLVE INCORRECT VOLTAGE LEVELS, REFER TO FRONT PANEL INTERFACE TROUBLESHOOTING, PARA.

SIGNALS

SIGNAL 7 400 HZ AT 0.7 VRMS.
SIGNAL 8 400 HZ AT 0.3 mVRS.
SIGNAL 9 455 KHZ UNMOD. AT -28 dbm.

Figure 4-1b. Corrective Maintenance Flowchart

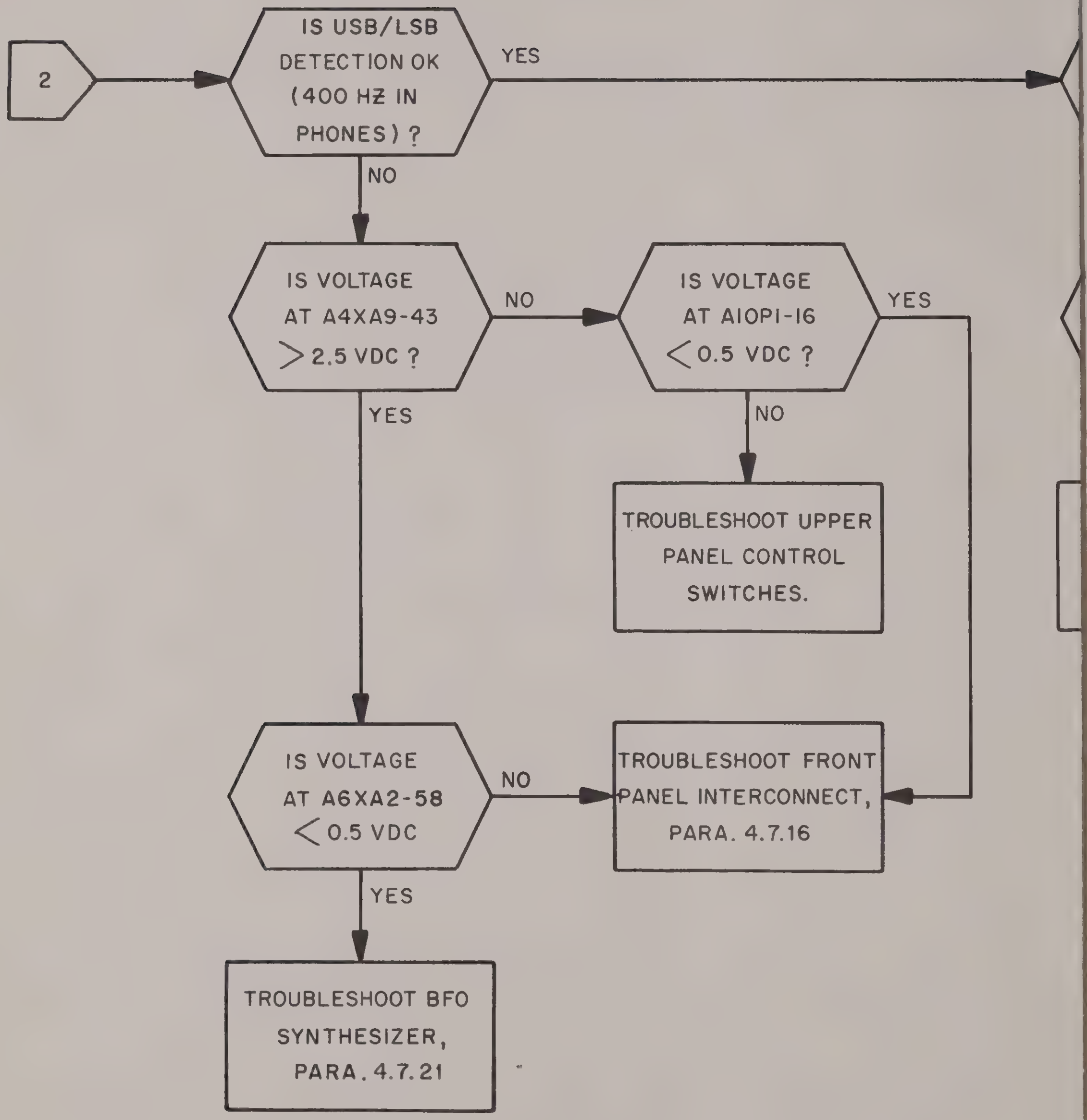

2
IS USB/LSB DETECTION OK (400 HZ IN PHONES) ?
YES
NO
IS VOLTAGE AT A4XA9-43 > 2.5 VDC ?
NO
IS VOLTAGE AT A1OP1-16 < 0.5 VDC ?
YES
NO
TROUBLESHOOT UPPER PANEL CONTROL SWITCHES.
YES
IS VOLTAGE AT A6XA2-58 < 0.5 VDC
NO
TROUBLESHOOT FRONT PANEL INTERCONNECT, PARA. 4.7.16
YES
TROUBLESHOOT BFO SYNTHESIZER, PARA. 4.7.21

Figure 4-1c. Corrective Maintenance Flowchart

5. All equipment covers shall be in place unless a particular test requires their removal.

6. The tests should be performed in the order given. If a receiver problem is noted, refer to paragraph 4.7 for troubleshooting information.

4.6.4 OPERATOR PERFORMANCE TEST

1. Set receiver controls as follows:

    a. RF Gain - Maximum Counterclockwise
    b. Phone Level - Maximum Counterclockwise
    c. IF Bandwidth - 16 kHz
    d. Tuning Rate - Disable
    e. BFO Offset - +0.0
    f. Detection Mode - AM
    g. Gain Mode - Manual
    h. Meter - Signal Strength

2. Insure that the receiver Line Voltage Selector matches the available line voltage.

3. Energize the receiver by depressing the POWER PUSH ON/OFF switch on the front panel.

4. The Frequency Display should illuminate almost instantly. Display intensity should be bright and uniform.

5. Depress the 10 Hz tuning rate button and rotate the tuning knob until the 10 Hz Frequency Display digit reads 0.

6. Depress the 100 Hz tuning rate button and rotate the tuning knob until the 100 Hz Frequency Display digit reads 0.

7. Depress the 1 kHz tuning rate button and rotate the tuning knob until the 1 kHz Frequency Display digit reads 0.

8. Depress the 10 kHz tuning rate button and rotate the tuning knob until all the remaining Frequency Display digits read 0.

9. Deenergize the receiver.

4.6.5 IF GAIN AND BANDWIDTH PERFORMANCE TEST

1. Connect the test equipment to receiver as shown in Figure 4-2.

2. Set the Signal Generator output frequency to 15.00500 MHz unmodulated and output level to -103 dBm.

3. Set the RF Voltmeter to -20 dBm range.

4. Set the receiver controls as follows:

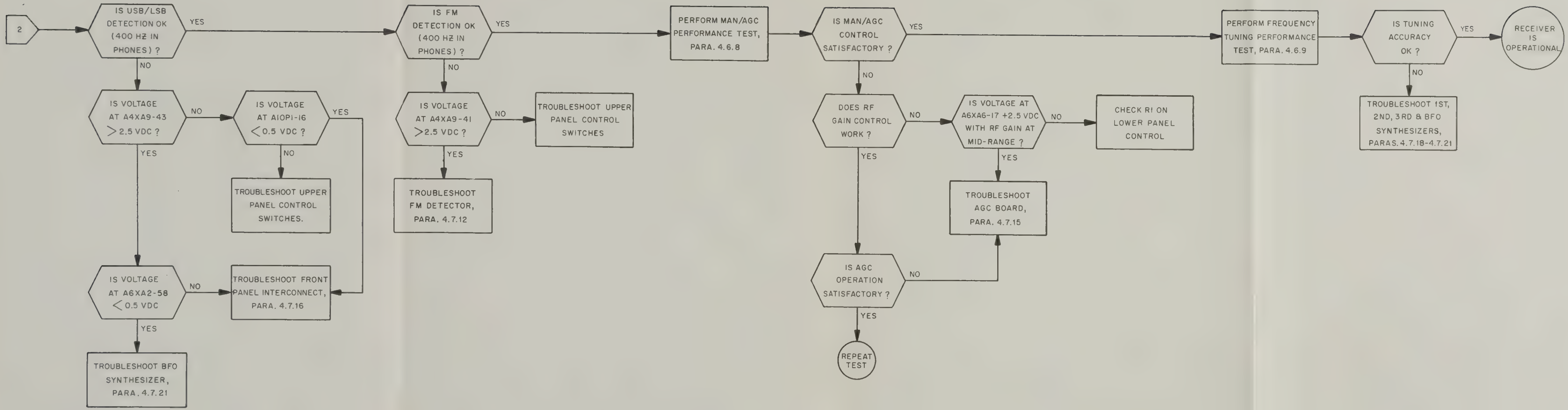

2
IS USB/LSB DETECTION OK (400 HZ IN PHONES) ?
YES
NO
IS VOLTAGE AT A4XA9-43 > 2.5 VDC ?
NO
IS VOLTAGE AT A1OP1-16 < 0.5 VDC ?
YES
NO
TROUBLESHOOT UPPER PANEL CONTROL SWITCHES.
YES
IS VOLTAGE AT A6XA2-58 < 0.5 VDC
NO
TROUBLESHOOT FRONT PANEL INTERCONNECT, PARA. 4.7.16
YES
TROUBLESHOOT BFO SYNTHESIZER, PARA. 4.7.21
IS FM DETECTION OK (400 HZ IN PHONES) ?
YES
NO
IS VOLTAGE AT A4XA9-41 >2.5 VDC ?
NO
TROUBLESHOOT UPPER PANEL CONTROL SWITCHES
YES
TROUBLESHOOT FM DETECTOR, PARA. 4.7.12
PERFORM MAN/AGC PERFORMANCE TEST, PARA. 4.6.8
IS MAN/AGC CONTROL SATISFACTORY ?
YES
NO
DOES RF GAIN CONTROL WORK ?
NO
IS VOLTAGE AT A6XA6-17 +2.5 VDC WITH RF GAIN AT MID-RANGE ?
NO
CHECK R1 ON LOWER PANEL CONTROL
YES
TROUBLESHOOT AGC BOARD, PARA. 4.7.15
YES
IS AGC OPERATION SATISFACTORY ?
NO
YES
REPEAT TEST
PERFORM FREQUENCY TUNING PERFORMANCE TEST, PARA. 4.6.9
IS TUNING ACCURACY OK ?
YES
RECEIVER IS OPERATIONAL
NO
TROUBLESHOOT 1ST, 2ND, 3RD & BFO SYNTHESIZERS, PARAS. 4.7.18-4.7.21

Figure 4-1c. Corrective Maintenance Flowchart

5. All equipment covers shall be in place unless a particular test requires their removal.

6. The tests should be performed in the order given. If a receiver problem is noted, refer to paragraph 4.7 for troubleshooting information.

4.6.4 OPERATOR PERFORMANCE TEST

1. Set receiver controls as follows:

a.	RF Gain	-	Maximum Counterclockwise
b.	Phone Level	-	Maximum Counterclockwise
c.	IF Bandwidth	-	16 kHz
d.	Tuning Rate	-	Disable
e.	BFO Offset	-	+0.0
f.	Detection Mode	-	AM
g.	Gain Mode	-	Manual
h.	Meter	-	Signal Strength

2. Insure that the receiver Line Voltage Selector matches the available line voltage.

3. Energize the receiver by depressing the POWER PUSH ON/OFF switch on the front panel.

4. The Frequency Display should illuminate almost instantly. Display intensity should be bright and uniform.

5. Depress the 10 Hz tuning rate button and rotate the tuning knob until the 10 Hz Frequency Display digit reads 0.

6. Depress the 100 Hz tuning rate button and rotate the tuning knob until the 100 Hz Frequency Display digit reads 0.

7. Depress the 1 kHz tuning rate button and rotate the tuning knob until the 1 kHz Frequency Display digit reads 0.

8. Depress the 10 kHz tuning rate button and rotate the tuning knob until all the remaining Frequency Display digits read 0.

9. Deenergize the receiver.

4.6.5 IF GAIN AND BANDWIDTH PERFORMANCE TEST

1. Connect the test equipment to receiver as shown in Figure 4-2.

2. Set the Signal Generator output frequency to 15.00500 MHz unmodulated and output level to -103 dBm.

3. Set the RF Voltmeter to -20 dBm range.

4. Set the receiver controls as follows:

a. RF Gain - Maximum Clockwise
b. Phone Level - Maximum Counterclockwise
c. IF Bandwidth - 16 kHz
d. Tuning Rate - Disable
e. Detection Mode - AM
f. Gain Mode - Manual
g. Meter - Signal Strength
h. Power - OFF

5. Energize the receiver by depressing the POWER ON pushbutton.

6. Select the appropriate tuning rate buttons and use the frequency control to tune the receiver to 15.00500 MHz.

7. The Signal Strength meter should indicate a reading of 1/4 to 1/2 full scale and the RF Voltmeter should indicate -21 dBm ±2 dBm.

8. Depress the 6 kHz, 3 kHz, 1 kHz, and 0.3 kHz pushbuttons in succession. For each bandwidth, the RF Voltmeter should indicate -21 dBm ±2 dBm.

9. Set the Generator output frequency to 15.00650 MHz. Depress the USB button. The RF Voltmeter should indicate -21 dBm ±2 dBm.

10. Set the Generator output frequency to 15.00350 MHz. Depress the LSB button. The RF Voltmeter should indicate -21 dBm ±2 dBm.

11. Disconnect the Signal Generator from the RF Input Jack, A2J1, and connect a 50 Ω termination to A2J1.

12. Depress the receiver AM Mode switch and the 16 kHz BW switch. The RF Voltmeter should indicate -38 dBm ±2 dBm.

13. Depress the receiver 6 kHz BW switch. The RF Voltmeter should indicate -42 dBm ±2 dBm.

14. Depress the receiver 3 kHz BW switch. The RF Voltmeter should indicate -45 dBm ±2 dBm.

15. Depress the receiver USB Mode switch and then the LSB Mode switch. The RF Voltmeter should indicate -45 dBm ±2 dBm for both modes.

16. Depress the receiver AM Mode switch and the 1 kHz BW switch. The RF Voltmeter should indicate -50 dBm ±2 dBm.

17. Depress the receiver 0.3 kHz BW switch. The RF Voltmeter should indicate -55 dBm ±2 dBm.

18. Deenergize the receiver and disconnect the test equipment.

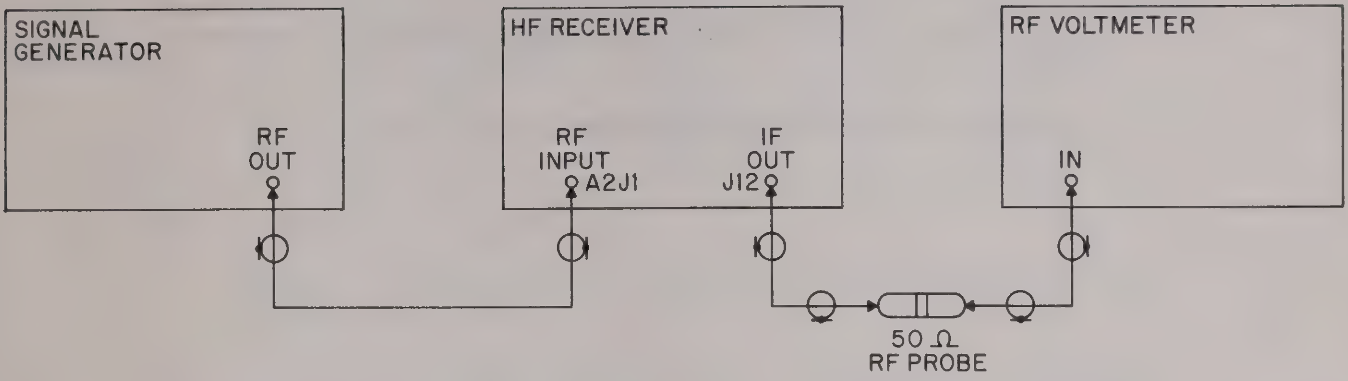


Figure 4-2. IF Gain and Bandwidth Performance, Test Setup

4.6.6 S/N RATIO PERFORMANCE TEST

1. Connect the test equipment to the receiver as shown in Figure 4-3.

2. Set the Signal Generator output frequency to 29.99990 MHz unmodulated and output level to -103 dBm.

3. Set the RF Voltmeter to the -20 dBm range.

4. Set the receiver controls as follows:

   a. RF Gain - Maximum Clockwise
   b. Phone Level - Maximum Counterclockwise
   c. IF Bandwidth - 6 kHz
   d. Tuning Rate - Disable
   e. Detection Mode - AM
   f. Gain Mode - Manual
   g. Meter - Signal Strength
   h. Power - OFF

5. Energize the receiver by depressing the POWER ON pushbutton.

6. Select the appropriate tuning rate buttons and use the frequency control to tune the receiver to 29.99990 MHz.

7. Record the IF Output Level indicated on the RF Voltmeter (~ -21 dBm).
8. Turn the Signal Generator RF ON/OFF switch to the OFF position.
9. The reading on the RF Voltmeter should decrease by at least 10 dB.
10. Deenergize the receiver and disconnect test equipment.

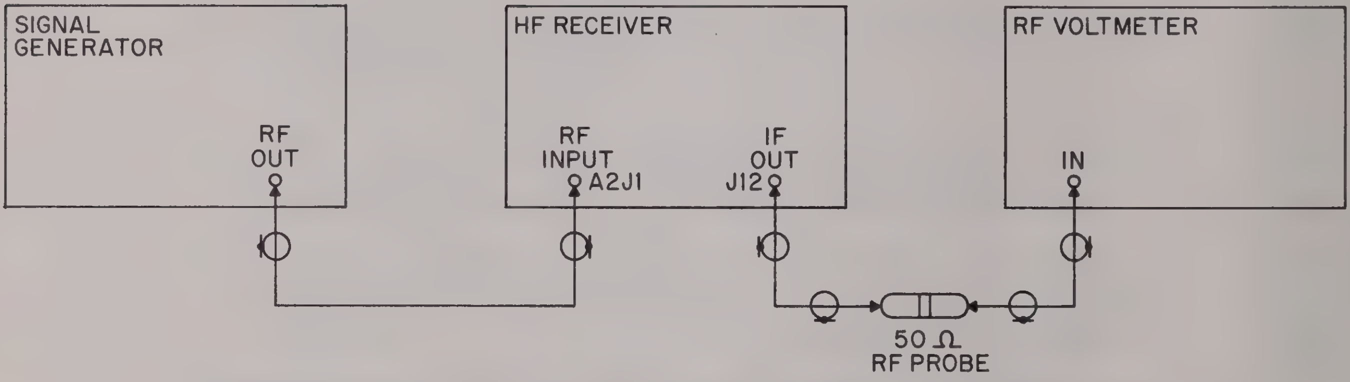


Figure 4-3. S/N Ratio Performance, Test Setup

4.6.7 DETECTION MODE PERFORMANCE TEST

1. Connect test equipment to the receiver as shown in Figure 4-4.
2. Set the Signal Generator output frequency to 15.00500 MHz and output level to -97 dBm. Set the Generator for 50% AM modulation at 400 Hz.
3. Set the Voltmeter to the 50 Vac range.
4. Set the Oscilloscope to display the A vertical input.

5. Set the receiver controls as follows:

    a. RF Gain - Maximum Clockwise
    b. Phone Level - Maximum Counterclockwise
    c. Line Audio - Maximum Counterclockwise
    d. IF Bandwidth - 6 kHz
    e. Tuning Rate - Disable
    f. Detection Mode - AM
    g. Gain Mode - Manual
    h. Meter - Line Audio
    i. Power - OFF

6. Energize the receiver.

7. Select the appropriate tuning rate buttons and tune to 15.00500 MHz.

8. Rotate the PHONE LEVEL control clockwise until a 400 Hz tone is heard in the headphones at a comfortable listening level. The tone should be clear and distinct, and free from noise, hum, and other signal distortions.

9. Rotate the LINE AUDIO control clockwise until the Voltmeter indicates 34.6 Vac.

CAUTION

> Line Audio output levels in excess of 35 Vac may cause damage to the receiver and/or the 600 Ω load resistor.

10. The Oscilloscope should show a clean sine wave with no evidence of clipping or distortion.

11. Turn off the Signal Generator modulation.

12. Depress the receiver CW and 1 kHz buttons. Set the receiver BFO OFFSET to +0.4 kHz.

13. A clear, distinct 400 Hz tone should be heard in the headphones.

14. Set the Signal Generator output frequency to 15.00540 MHz. Depress the receiver USB button.

15. A clear, distinct 400 Hz tone should be heard in the headphones.

16. Set the Signal Generator output frequency to 15.00460 MHz.

17. Depress the receiver LSB button. A clear, distinct 400 Hz tone should be heard in the headphones.

18. Depress the receiver ISB button. A clear, distinct 400 Hz tone should be heard in the headphones.

19. Depress the Oscilloscope B vertical input button. The Oscilloscope should display a clean sine wave at ~22 volts p-p with no evidence of clipping or distortion.
20. Set the Signal Generator output frequency to 15.0050 MHz. Set the Generator Modulation to FM, modulation frequency to 400 Hz, and deviation to 4.8 kHz.
21. Depress the receiver 16 kHz and FM buttons.
22. A clear, distinct 400 Hz tone should be heard in the headphones.
23. Deenergize the receiver and disconnect test equipment.

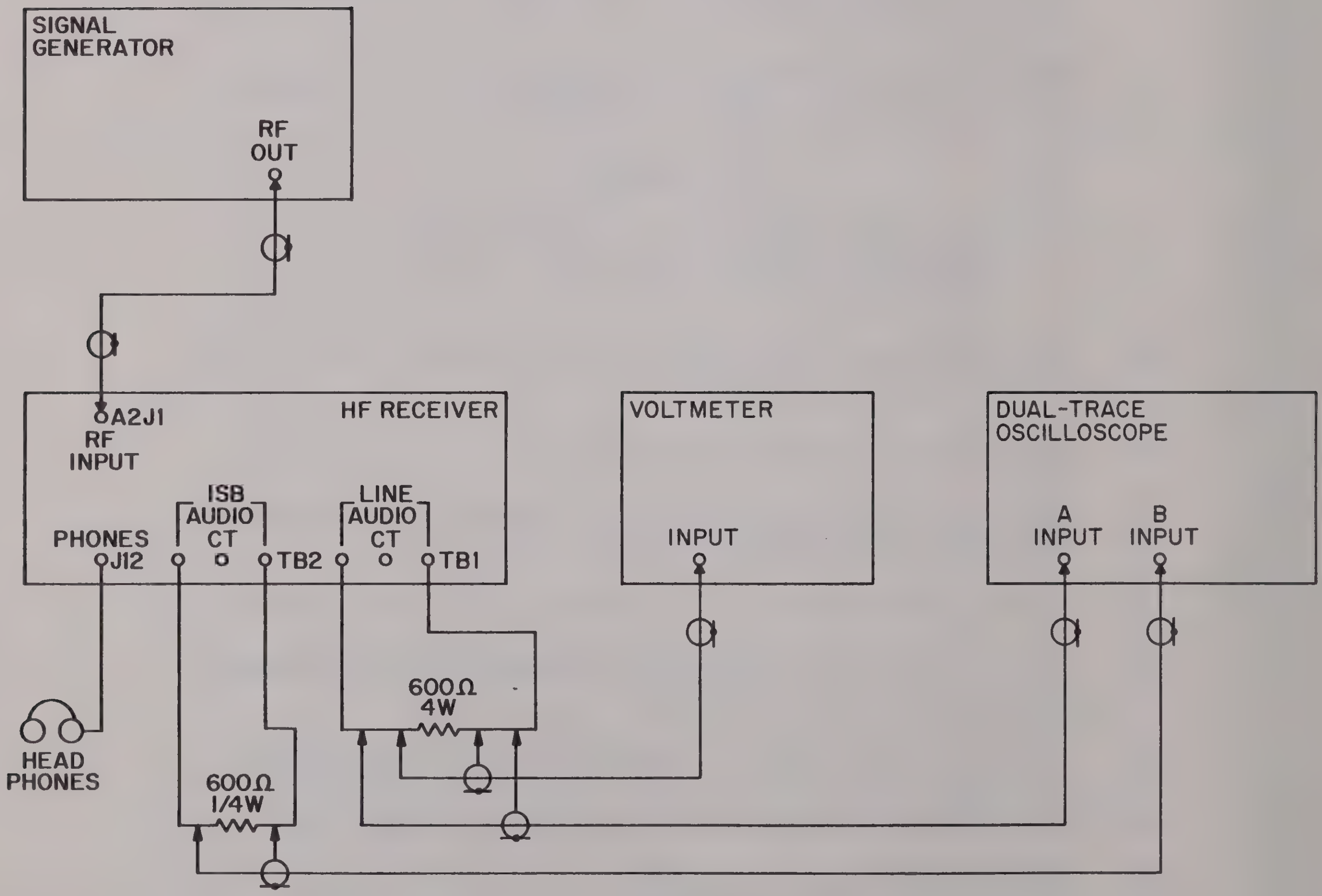


Figure 4-4. Detection Mode Performance, Test Setup

4.6.8 MAN/AGC PERFORMANCE TEST

1. Connect the test equipment to the receiver as shown in Figure 4-5.

2. Set the Signal Generator output frequency to 15.00500 MHz and output level to -97 dBm. Set the Generator for 50% AM modulation at 400 Hz.

3. Set the Voltmeter to the 50 Vac range.

4. Set the receiver controls as follows:

a.	RF Gain	–	Maximum Clockwise
b.	IF Bandwidth	–	6 kHz
c.	Tuning Rate	–	Disable
d.	Detection Mode	–	AM
e.	Gain Mode	–	Manual
f.	Power	–	OFF

5. Energize the receiver.

6. Select the appropriate tuning rate buttons and tune the receiver to 15.00500 MHz.

7. Adjust the Line Audio control for an indication of 34.6 Vac on the Voltmeter.

8. Turn the receiver RF Gain control fully counterclockwise.

9. Increase the Signal Generator output level to +3 dBm.

10. The Voltmeter should indicate less than 34.6 Vac. Rotate the receiver RF Gain control clockwise until the Voltmeter indicates 34.6 Vac.

11. Decrease the Signal Generator output level to -87 dBm.

12. Select the receiver AGC Fast Gain Mode.

13. Adjust the receiver Line Audio control for an indication of 17.3 Vac on the Voltmeter.

14. Increase the Generator output level to -7 dBm. The reading on the Voltmeter should be no greater than 34.6 Vac.

15. Select the receiver AGC Slow Gain Mode. The reading on the Voltmeter should not change.

16. Deenergize the receiver and disconnect test equipment.

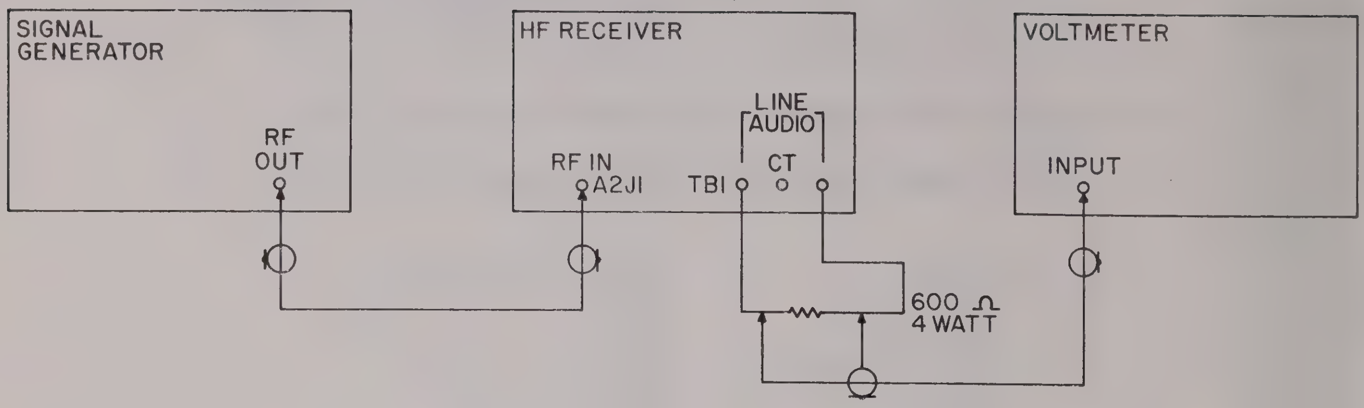


Figure 4-5. MAN/AGC Performance, Test Setup

4.6.9 FREQUENCY TUNING PERFORMANCE TEST

1. Connect the test equipment to the receiver as shown in Figure 4-6.

2. Set the Signal Generator output frequency to 00.50001 MHz, unmodulated, and output level to -97 dBm.

3. Set the Frequency Counter to provide 10 Hz resolution at a 1 sec sample rate.

4. Set the receiver controls as follows:

a.	IF Bandwidth	-	6 kHz
b.	Tuning Rate	-	Disable
c.	Detection Mode	-	AM
d.	Gain Mode	-	Fast AGC
e.	Power	-	OFF

5. Energize the receiver.

6. Select the appropriate tuning rate buttons and tune receiver to 00.50001 MHz.

7. The Frequency Counter should indicate an IF output frequency of 455.00 kHz ±0.10 kHz.

8. Increase the Signal Generator output frequency to 29.99999 MHz.

9. Tune the receiver to 29.99999 MHz.

10. The Frequency Counter should indicate an IF output frequency of 455.00 kHz ±0.10 kHz.

11. Deenergize the receiver and disconnect the test equipment.

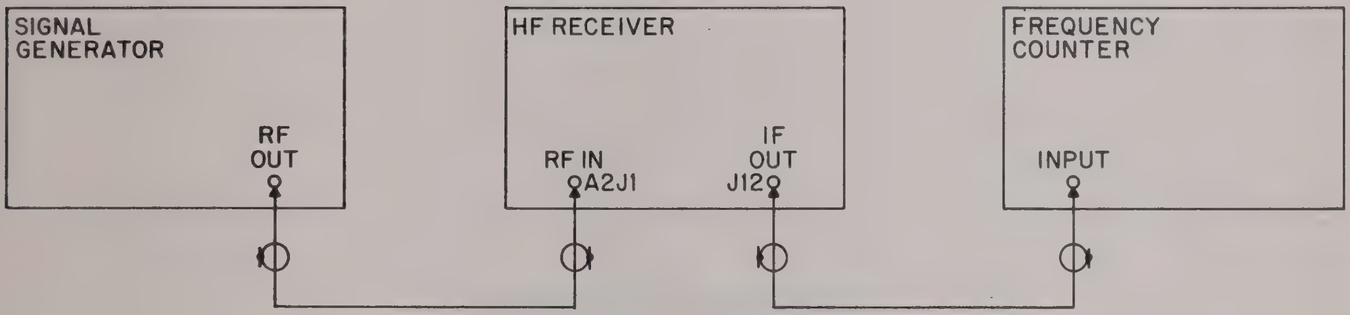


Figure 4-6. Frequency Tuning Performance, Test Setup.

THIS PAGE LEFT BLANK

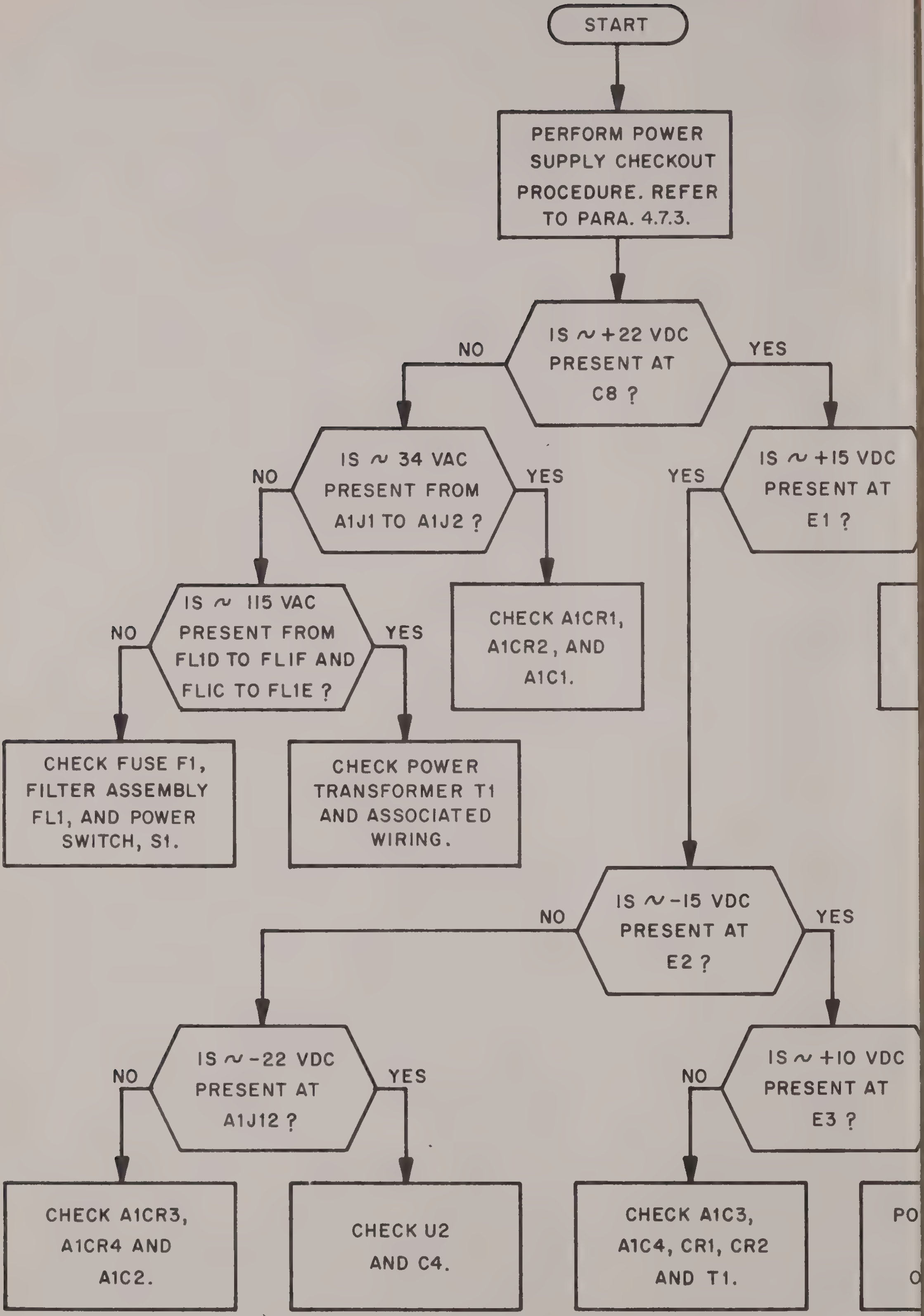

START
PERFORM POWER SUPPLY CHECKOUT PROCEDURE. REFER TO PARA. 4.7.3.
IS ~ +22 VDC PRESENT AT C8 ?
NO
YES
IS ~ 34 VAC PRESENT FROM A1J1 TO A1J2 ?
NO
YES
IS ~ +15 VDC PRESENT AT E1 ?
YES
IS ~ 115 VAC PRESENT FROM FL1D TO FL1F AND FL1C TO FL1E ?
NO
YES
CHECK A1CR1, A1CR2, AND A1C1.
CHECK FUSE F1, FILTER ASSEMBLY FL1, AND POWER SWITCH, S1.
CHECK POWER TRANSFORMER T1 AND ASSOCIATED WIRING.
IS ~ -15 VDC PRESENT AT E2 ?
NO
YES
IS ~ -22 VDC PRESENT AT A1J12 ?
NO
YES
IS ~ +10 VDC PRESENT AT E3 ?
NO
CHECK A1CR3, A1CR4 AND A1C2.
CHECK U2 AND C4.
CHECK A1C3, A1C4, CR1, CR2 AND T1.
PO
O

Figure 4-7. Power Supply Troubleshooting Tree

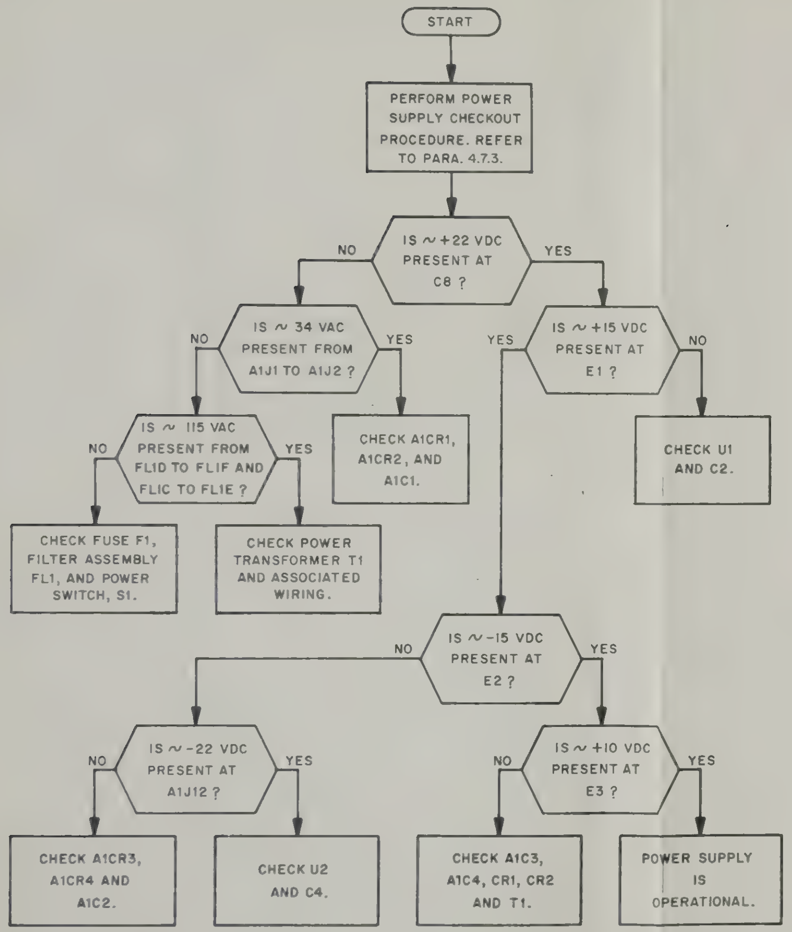

START
PERFORM POWER SUPPLY CHECKOUT PROCEDURE. REFER TO PARA. 4.7.3.
IS ~ +22 VDC PRESENT AT C8 ?
NO
YES
IS ~ 34 VAC PRESENT FROM A1J1 TO A1J2 ?
NO
YES
IS ~ +15 VDC PRESENT AT E1 ?
YES
NO
IS ~ 115 VAC PRESENT FROM FL1D TO FL1F AND FL1C TO FL1E ?
NO
YES
CHECK A1CR1, A1CR2, AND A1C1.
CHECK U1 AND C2.
CHECK FUSE F1, FILTER ASSEMBLY FL1, AND POWER SWITCH, S1.
CHECK POWER TRANSFORMER T1 AND ASSOCIATED WIRING.
IS ~ -15 VDC PRESENT AT E2 ?
NO
YES
IS ~ -22 VDC PRESENT AT A1J12 ?
NO
YES
IS ~ +10 VDC PRESENT AT E3 ?
NO
YES
CHECK A1CR3, A1CR4 AND A1C2.
CHECK U2 AND C4.
CHECK A1C3, A1C4, CR1, CR2 AND T1.
POWER SUPPLY IS OPERATIONAL.

Figure 4-7. Power Supply Troubleshooting Tree

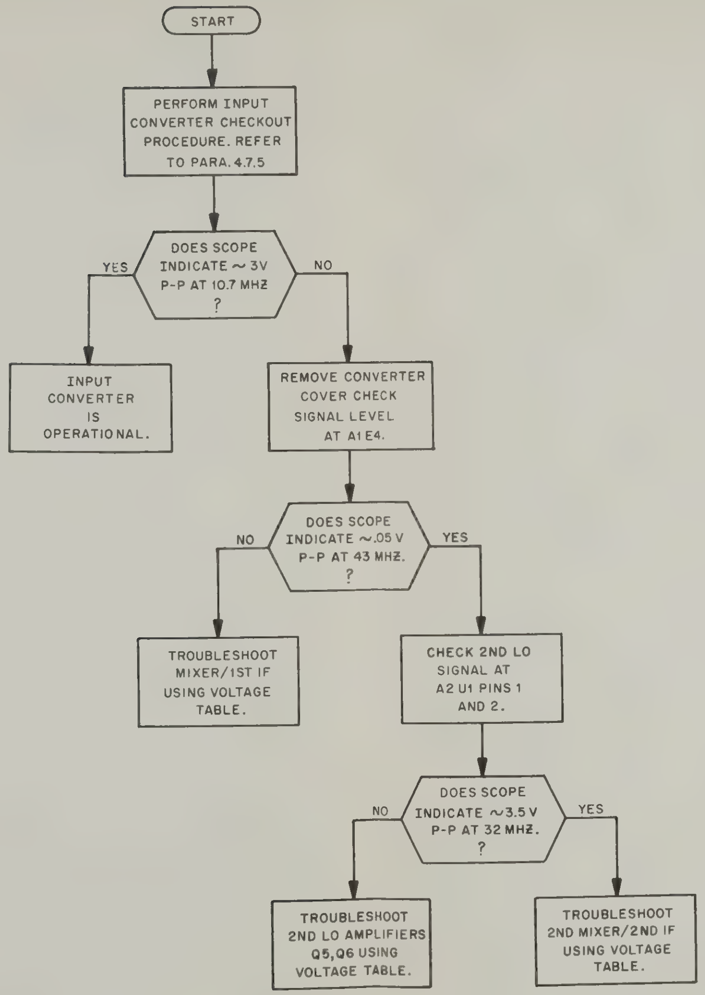

START
PERFORM INPUT CONVERTER CHECKOUT PROCEDURE. REFER TO PARA. 4.7.5
DOES SCOPE INDICATE ~ 3V P-P AT 10.7 MHZ ?
YES
NO
INPUT CONVERTER IS OPERATIONAL.
REMOVE CONVERTER COVER CHECK SIGNAL LEVEL AT A1 E4.
DOES SCOPE INDICATE ~.05 V P-P AT 43 MHZ. ?
NO
YES
TROUBLESHOOT MIXER/1ST IF USING VOLTAGE TABLE.
CHECK 2ND LO SIGNAL AT A2 U1 PINS 1 AND 2.
DOES SCOPE INDICATE ~3.5 V P-P AT 32 MHZ. ?
NO
YES
TROUBLESHOOT 2ND LO AMPLIFIERS Q5, Q6 USING VOLTAGE TABLE.
TROUBLESHOOT 2ND MIXER/2ND IF USING VOLTAGE TABLE.

Figure 4-8. Input Converter Troubleshooting Tree.

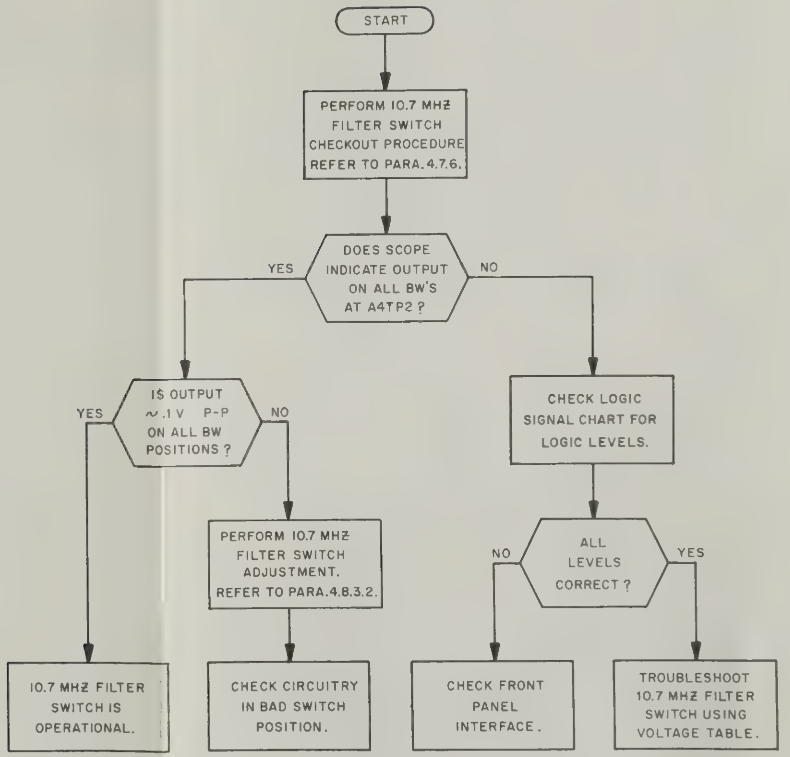

START
PERFORM 10.7 MHZ FILTER SWITCH CHECKOUT PROCEDURE REFER TO PARA. 4.7.6.
DOES SCOPE INDICATE OUTPUT ON ALL BW'S AT A4TP2 ?
YES
NO
IS OUTPUT ~.1 V P-P ON ALL BW POSITIONS ?
YES
NO
CHECK LOGIC SIGNAL CHART FOR LOGIC LEVELS.
PERFORM 10.7 MHZ FILTER SWITCH ADJUSTMENT. REFER TO PARA. 4.8.3.2.
ALL LEVELS CORRECT ?
NO
YES
10.7 MHZ FILTER SWITCH IS OPERATIONAL.
CHECK CIRCUITRY IN BAD SWITCH POSITION.
CHECK FRONT PANEL INTERFACE.
TROUBLESHOOT 10.7 MHZ FILTER SWITCH USING VOLTAGE TABLE.

Figure 4-9. 10.7 MHz Filter Switch Troubleshooting Tree.

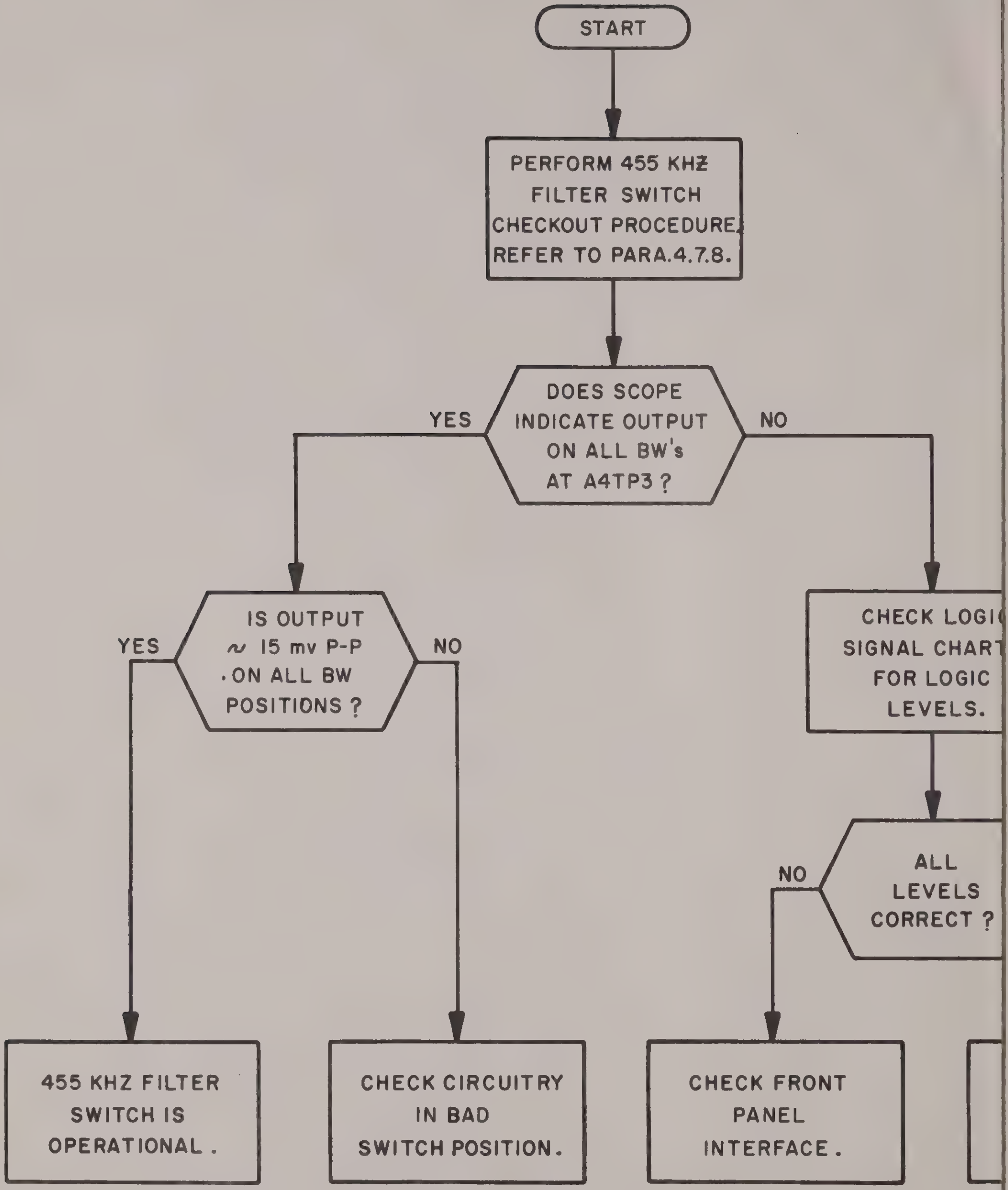

START
PERFORM 455 KHZ FILTER SWITCH CHECKOUT PROCEDURE. REFER TO PARA.4.7.8.
DOES SCOPE INDICATE OUTPUT ON ALL BW's AT A4TP3 ?
YES
NO
IS OUTPUT ≈ 15 mv P-P ON ALL BW POSITIONS ?
YES
NO
CHECK LOGI
SIGNAL CHART
FOR LOGIC
LEVELS.
ALL LEVELS CORRECT ?
NO
455 KHZ FILTER SWITCH IS OPERATIONAL.
CHECK CIRCUITRY IN BAD SWITCH POSITION.
CHECK FRONT PANEL INTERFACE.

Figure 4-10. 455 kHz Filter Switch Troubleshooting Tree

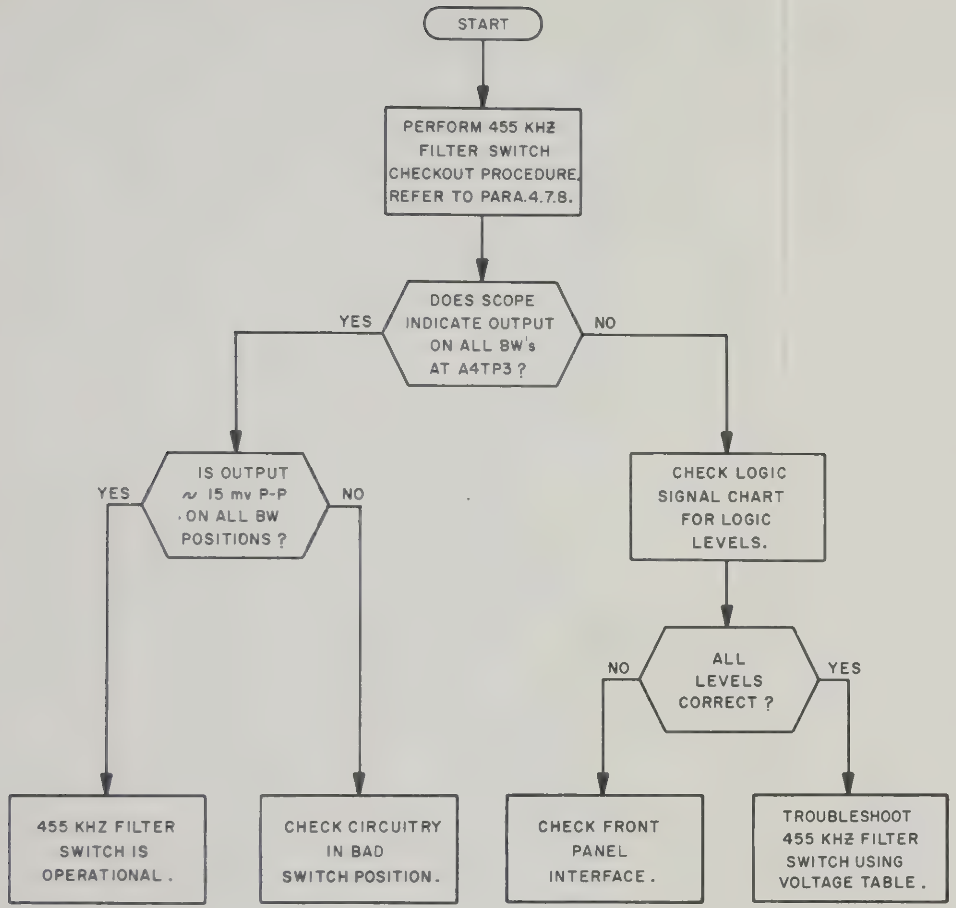

START
PERFORM 455 KHZ FILTER SWITCH CHECKOUT PROCEDURE, REFER TO PARA.4.7.8.
DOES SCOPE INDICATE OUTPUT ON ALL BW's AT A4TP3 ?
YES
NO
IS OUTPUT ~ 15 mv P-P ON ALL BW POSITIONS ?
YES
NO
CHECK LOGIC SIGNAL CHART FOR LOGIC LEVELS.
ALL LEVELS CORRECT ?
NO
YES
455 KHZ FILTER SWITCH IS OPERATIONAL.
CHECK CIRCUITRY IN BAD SWITCH POSITION.
CHECK FRONT PANEL INTERFACE.
TROUBLESHOOT 455 KHZ FILTER SWITCH USING VOLTAGE TABLE.

Figure 4-10. 455 kHz Filter Switch Troubleshooting Tree

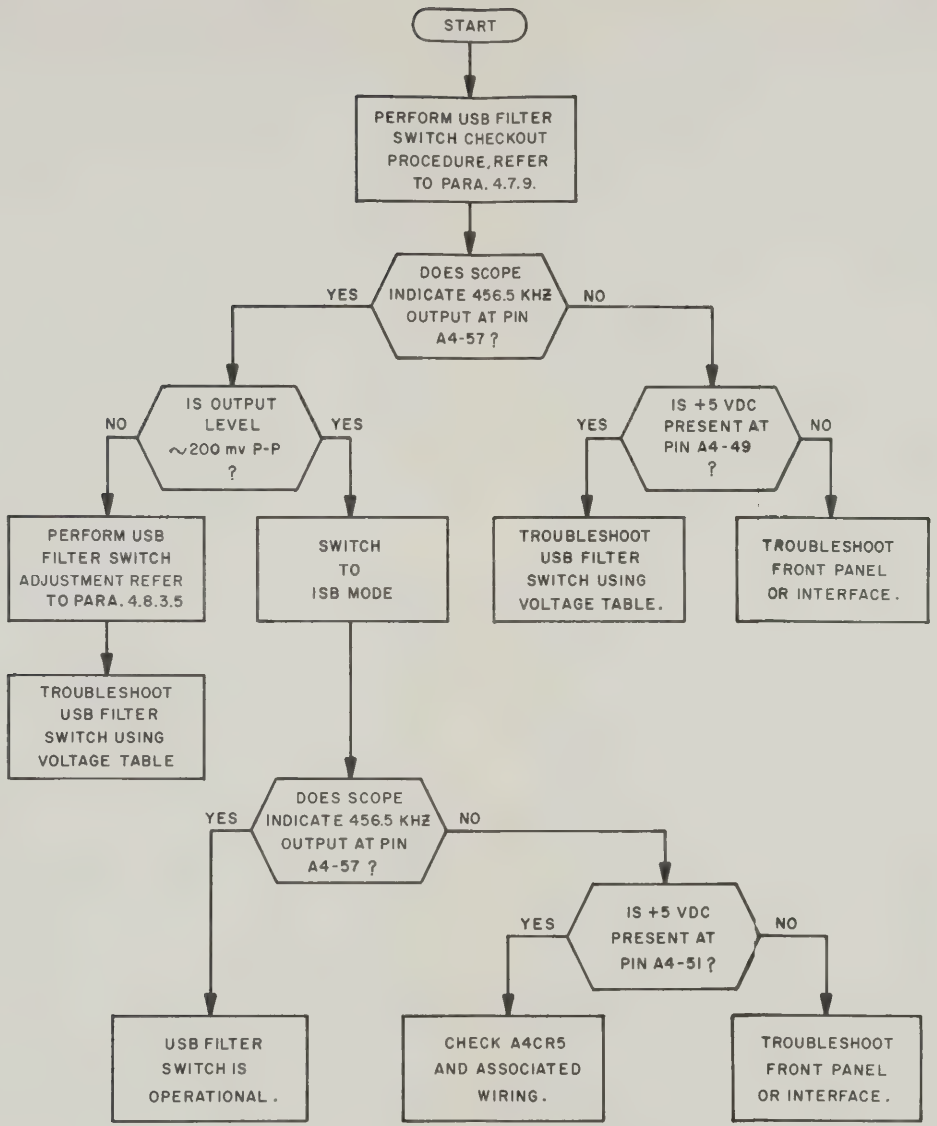

START
PERFORM USB FILTER SWITCH CHECKOUT PROCEDURE, REFER TO PARA. 4.7.9.
DOES SCOPE INDICATE 456.5 KHZ OUTPUT AT PIN A4-57 ?
YES
NO
IS OUTPUT LEVEL ~200 mv P-P ?
NO
YES
IS +5 VDC PRESENT AT PIN A4-49 ?
YES
NO
PERFORM USB FILTER SWITCH ADJUSTMENT REFER TO PARA. 4.8.3.5
SWITCH TO ISB MODE
TROUBLESHOOT USB FILTER SWITCH USING VOLTAGE TABLE.
TROUBLESHOOT FRONT PANEL OR INTERFACE.
TROUBLESHOOT USB FILTER SWITCH USING VOLTAGE TABLE
DOES SCOPE INDICATE 456.5 KHZ OUTPUT AT PIN A4-57 ?
YES
NO
IS +5 VDC PRESENT AT PIN A4-51 ?
YES
NO
USB FILTER SWITCH IS OPERATIONAL.
CHECK A4CR5 AND ASSOCIATED WIRING.
TROUBLESHOOT FRONT PANEL OR INTERFACE.

Figure 4-11. USB Filter Switch Troubleshooting Tree

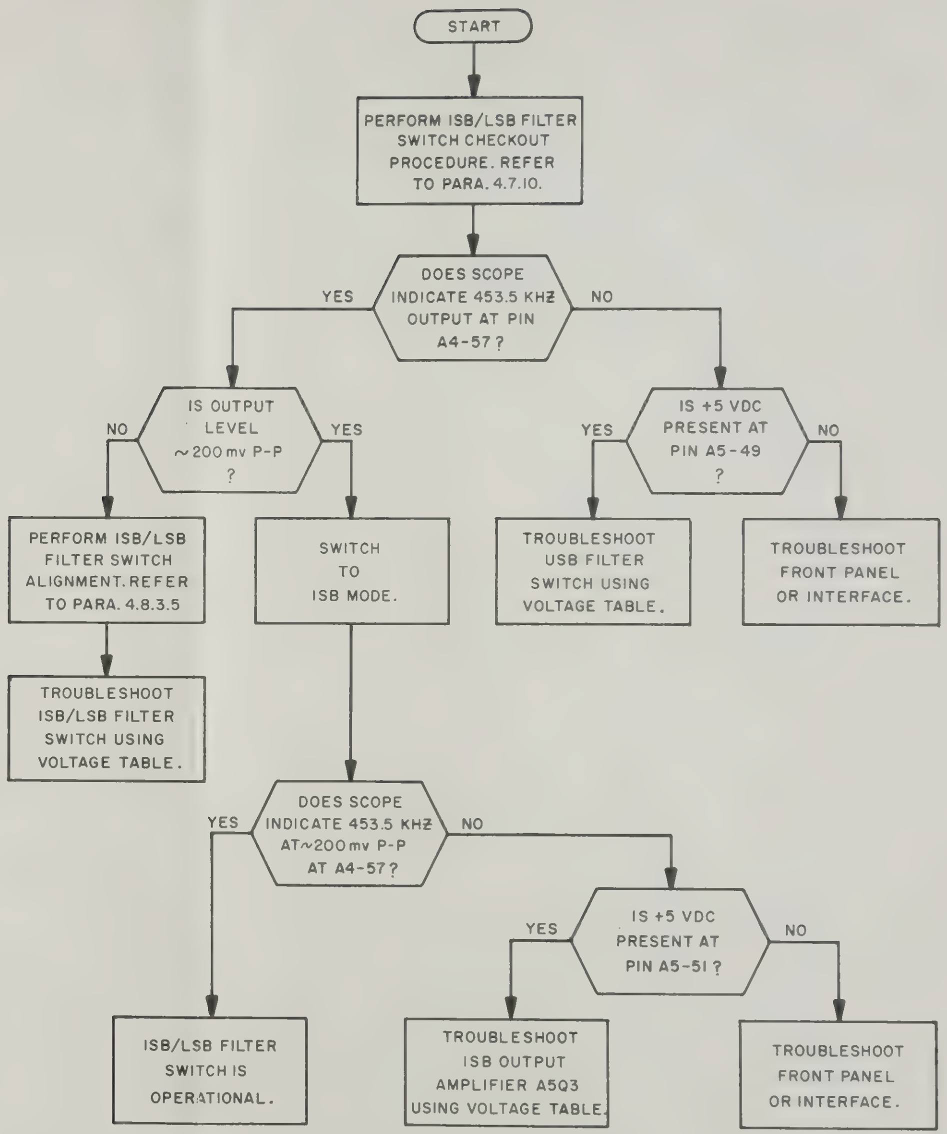

START
PERFORM ISB/LSB FILTER SWITCH CHECKOUT PROCEDURE. REFER TO PARA. 4.7.10.
DOES SCOPE INDICATE 453.5 KHZ OUTPUT AT PIN A4-57 ?
YES
NO
IS OUTPUT LEVEL ~200 mv P-P ?
NO
YES
IS +5 VDC PRESENT AT PIN A5-49 ?
YES
NO
PERFORM ISB/LSB FILTER SWITCH ALIGNMENT. REFER TO PARA. 4.8.3.5
SWITCH TO ISB MODE.
TROUBLESHOOT USB FILTER SWITCH USING VOLTAGE TABLE.
TROUBLESHOOT FRONT PANEL OR INTERFACE.
TROUBLESHOOT ISB/LSB FILTER SWITCH USING VOLTAGE TABLE.
DOES SCOPE INDICATE 453.5 KHZ AT~200 mv P-P AT A4-57 ?
YES
NO
IS +5 VDC PRESENT AT PIN A5-51 ?
YES
NO
ISB/LSB FILTER SWITCH IS OPERATIONAL.
TROUBLESHOOT ISB OUTPUT AMPLIFIER A5Q3 USING VOLTAGE TABLE.
TROUBLESHOOT FRONT PANEL OR INTERFACE.

Figure 4-12. ISB/LSB Filter Switch Troubleshooting Tree

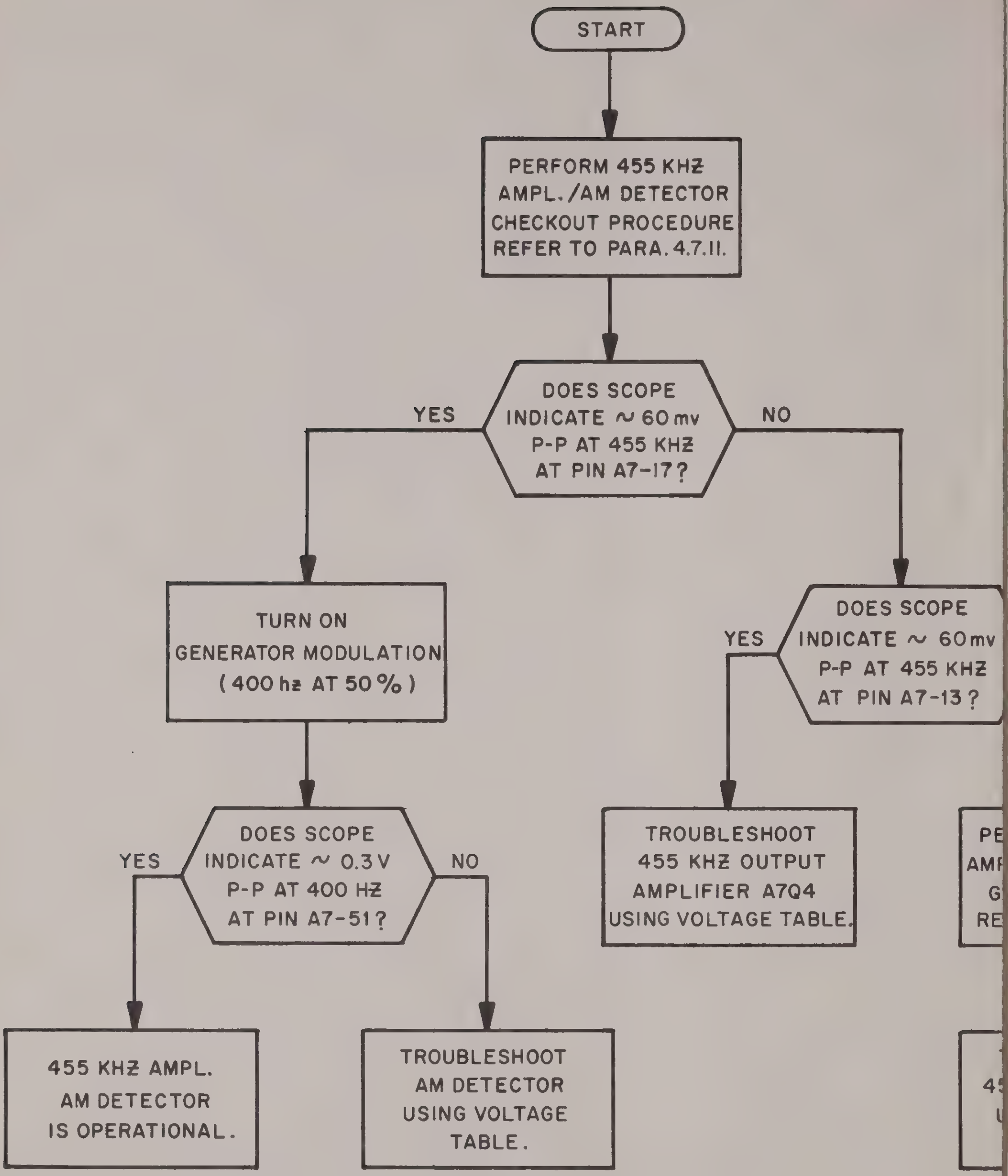

START
PERFORM 455 KHZ AMPL./AM DETECTOR CHECKOUT PROCEDURE REFER TO PARA. 4.7.11.
DOES SCOPE INDICATE ~ 60 mv P-P AT 455 KHZ AT PIN A7-17?
YES
NO
TURN ON GENERATOR MODULATION (400 hz AT 50 %)
DOES SCOPE INDICATE ~ 60 mv P-P AT 455 KHZ AT PIN A7-13?
YES
DOES SCOPE INDICATE ~ 0.3 V P-P AT 400 HZ AT PIN A7-51?
YES
NO
TROUBLESHOOT 455 KHZ OUTPUT AMPLIFIER A7Q4 USING VOLTAGE TABLE.
455 KHZ AMPL. AM DETECTOR IS OPERATIONAL.
TROUBLESHOOT AM DETECTOR USING VOLTAGE TABLE.

Figure 4-13. 455 kHz Amplifier/AM Detector Troubleshooting T

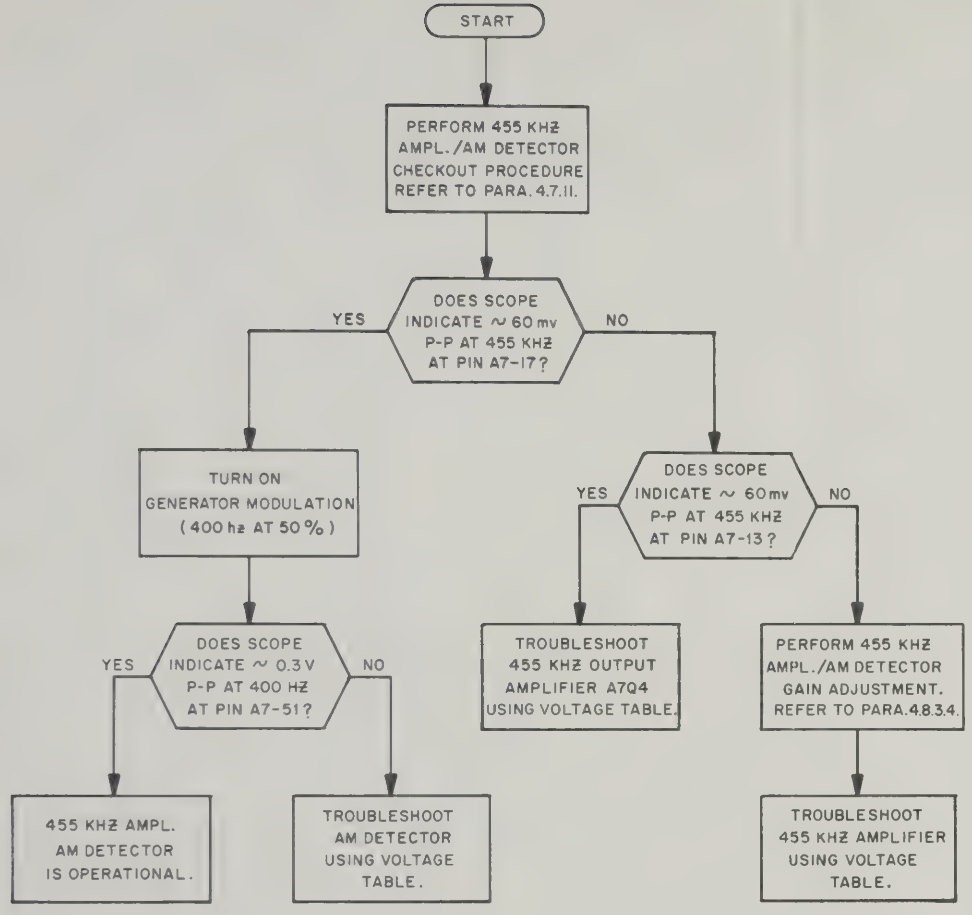

START
PERFORM 455 KHZ AMPL./AM DETECTOR CHECKOUT PROCEDURE REFER TO PARA. 4.7.11.
DOES SCOPE INDICATE ~ 60 mv P-P AT 455 KHZ AT PIN A7-17?
YES
NO
TURN ON GENERATOR MODULATION (400 hz AT 50%)
DOES SCOPE INDICATE ~ 0.3 V P-P AT 400 HZ AT PIN A7-51?
YES
NO
455 KHZ AMPL. AM DETECTOR IS OPERATIONAL.
TROUBLESHOOT AM DETECTOR USING VOLTAGE TABLE.
DOES SCOPE INDICATE ~ 60mv P-P AT 455 KHZ AT PIN A7-13?
YES
NO
TROUBLESHOOT 455 KHZ OUTPUT AMPLIFIER A7Q4 USING VOLTAGE TABLE.
PERFORM 455 KHZ AMPL./AM DETECTOR GAIN ADJUSTMENT. REFER TO PARA.4.8.3.4.
TROUBLESHOOT 455 KHZ AMPLIFIER USING VOLTAGE TABLE.

Figure 4-13. 455 kHz Amplifier/AM Detector Troubleshooting Tree

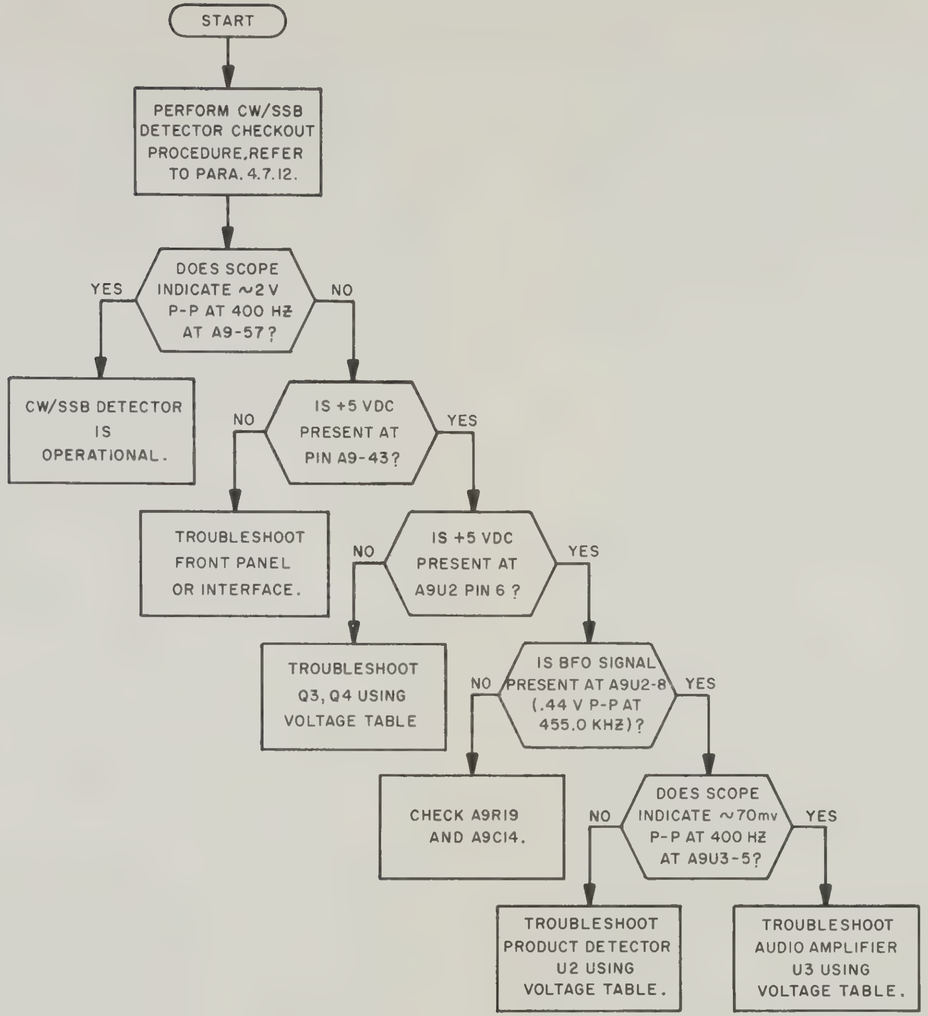

START
PERFORM CW/SSB DETECTOR CHECKOUT PROCEDURE, REFER TO PARA. 4.7.12.
DOES SCOPE INDICATE ~2 V P-P AT 400 HZ AT A9-57?
YES
NO
CW/SSB DETECTOR IS OPERATIONAL.
IS +5 VDC PRESENT AT PIN A9-43?
NO
YES
TROUBLESHOOT FRONT PANEL OR INTERFACE.
IS +5 VDC PRESENT AT A9U2 PIN 6?
NO
YES
TROUBLESHOOT Q3, Q4 USING VOLTAGE TABLE
IS BFO SIGNAL PRESENT AT A9U2-8 (.44 V P-P AT 455.0 KHZ)?
NO
YES
CHECK A9R19 AND A9C14.
DOES SCOPE INDICATE ~70mv P-P AT 400 HZ AT A9U3-5?
NO
YES
TROUBLESHOOT PRODUCT DETECTOR U2 USING VOLTAGE TABLE.
TROUBLESHOOT AUDIO AMPLIFIER U3 USING VOLTAGE TABLE.

Figure 4-14. CW/SSB Detector Troubleshooting Tree

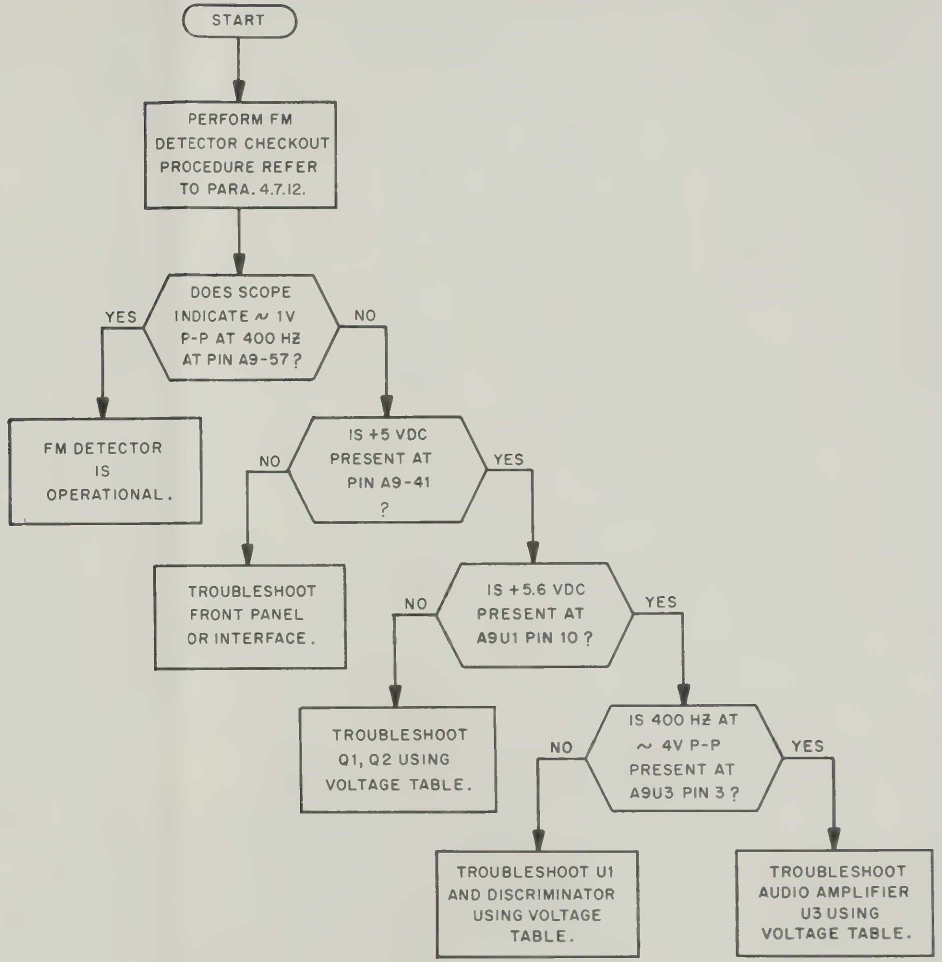

START
PERFORM FM DETECTOR CHECKOUT PROCEDURE REFER TO PARA. 4.7.12.
DOES SCOPE INDICATE ~ 1V P-P AT 400 HZ AT PIN A9-57?
YES
NO
FM DETECTOR IS OPERATIONAL.
IS +5 VDC PRESENT AT PIN A9-41 ?
NO
YES
TROUBLESHOOT FRONT PANEL OR INTERFACE.
IS +5.6 VDC PRESENT AT A9U1 PIN 10?
NO
YES
TROUBLESHOOT Q1, Q2 USING VOLTAGE TABLE.
IS 400 HZ AT ~ 4V P-P PRESENT AT A9U3 PIN 3?
NO
YES
TROUBLESHOOT U1 AND DISCRIMINATOR USING VOLTAGE TABLE.
TROUBLESHOOT AUDIO AMPLIFIER U3 USING VOLTAGE TABLE.

Figure 4-15. FM Detector Troubleshooting Tree

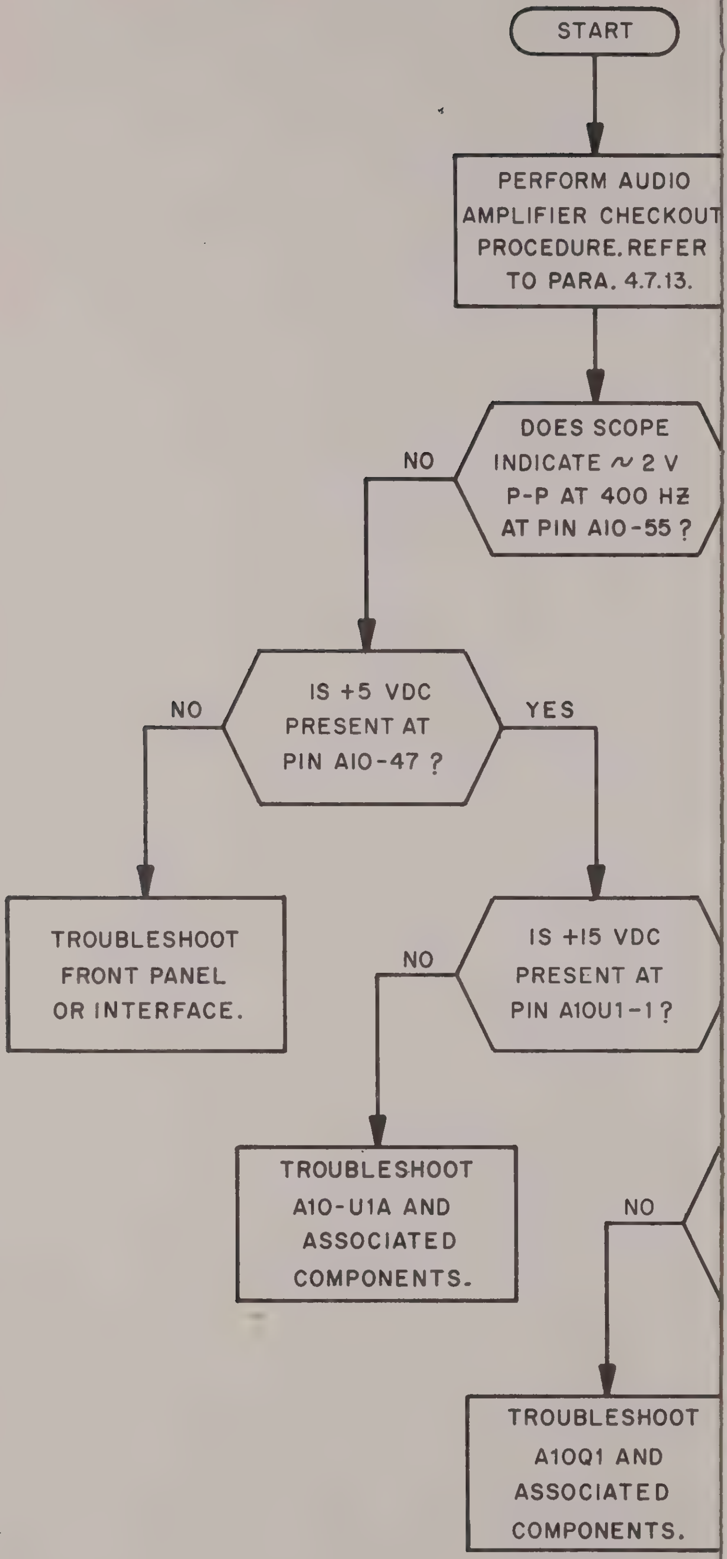

START
PERFORM AUDIO AMPLIFIER CHECKOUT PROCEDURE. REFER TO PARA. 4.7.13.
DOES SCOPE INDICATE ~ 2 V P-P AT 400 HZ AT PIN A10-55 ?
NO
IS +5 VDC PRESENT AT PIN A10-47 ?
NO
YES
TROUBLESHOOT FRONT PANEL OR INTERFACE.
IS +15 VDC PRESENT AT PIN A10U1-1 ?
NO
TROUBLESHOOT A10-U1A AND ASSOCIATED COMPONENTS.
NO
TROUBLESHOOT A10Q1 AND ASSOCIATED COMPONENTS.

Figure 4-16a. Audio Amplifier Tr

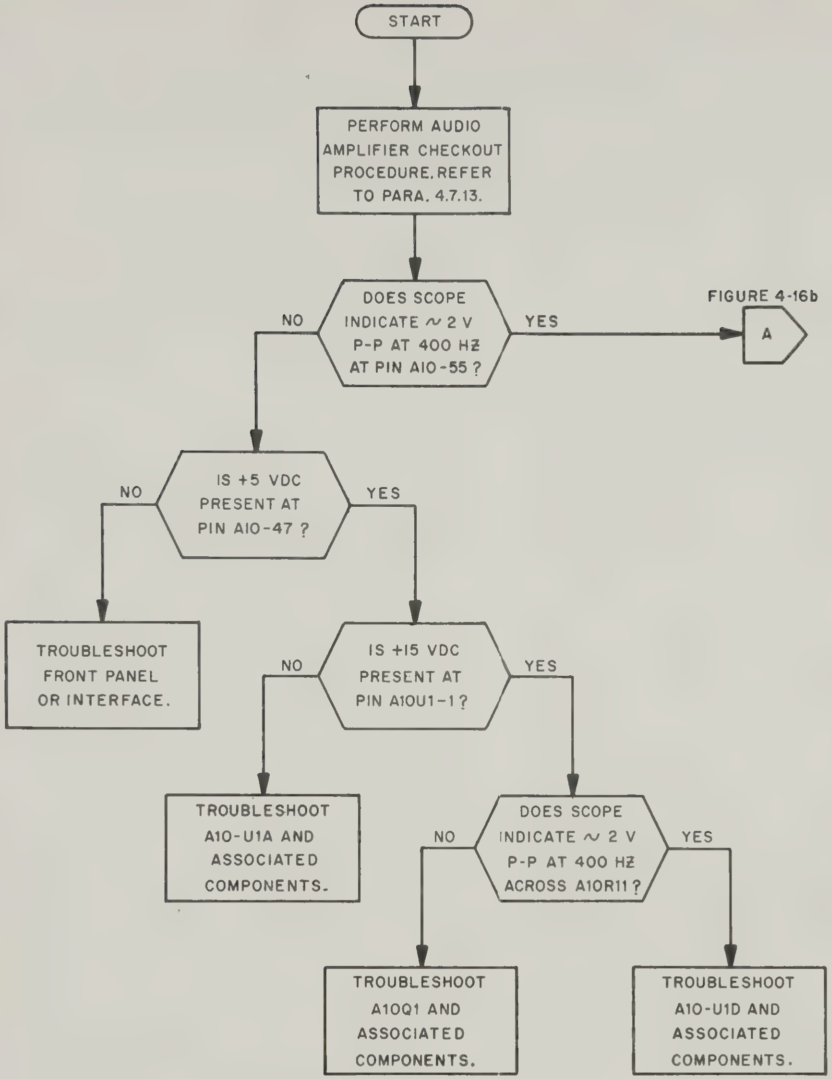

START
PERFORM AUDIO AMPLIFIER CHECKOUT PROCEDURE. REFER TO PARA. 4.7.13.
DOES SCOPE INDICATE ~ 2 V P-P AT 400 HZ AT PIN A10-55 ?
NO
YES
FIGURE 4-16b
A
IS +5 VDC PRESENT AT PIN A10-47 ?
NO
YES
TROUBLESHOOT FRONT PANEL OR INTERFACE.
IS +15 VDC PRESENT AT PIN A10U1-1 ?
NO
YES
TROUBLESHOOT A10-U1A AND ASSOCIATED COMPONENTS.
DOES SCOPE INDICATE ~ 2 V P-P AT 400 HZ ACROSS A10R11 ?
NO
YES
TROUBLESHOOT A10Q1 AND ASSOCIATED COMPONENTS.
TROUBLESHOOT A10-U1D AND ASSOCIATED COMPONENTS.

Figure 4-16a. Audio Amplifier Troubleshooting Tree

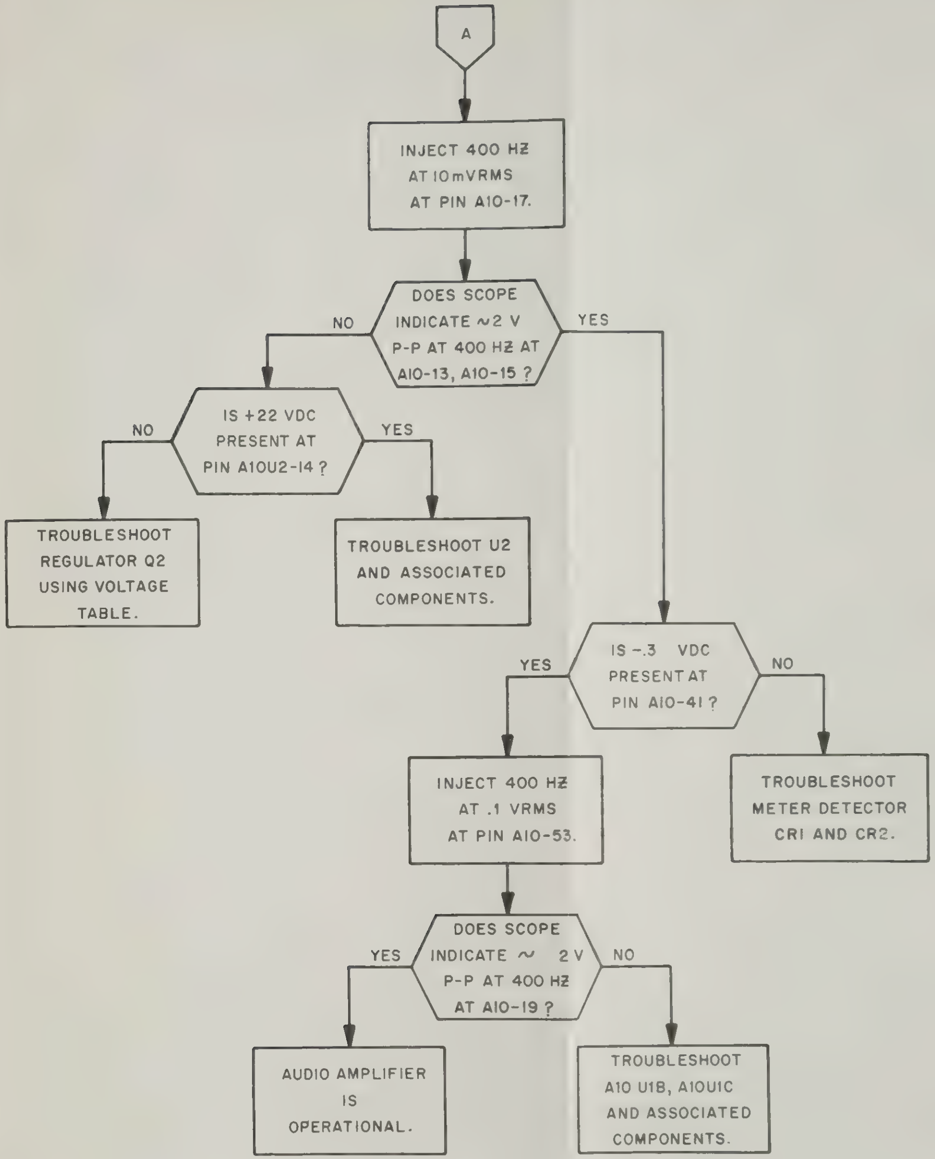

A
INJECT 400 HZ AT 10 mVRMS AT PIN A10-17.
DOES SCOPE INDICATE ~2 V P-P AT 400 HZ AT A10-13, A10-15 ?
NO
YES
IS +22 VDC PRESENT AT PIN A10U2-14 ?
NO
YES
TROUBLESHOOT REGULATOR Q2 USING VOLTAGE TABLE.
TROUBLESHOOT U2 AND ASSOCIATED COMPONENTS.
IS -.3 VDC PRESENT AT PIN A10-41 ?
YES
NO
INJECT 400 HZ AT .1 VRMS AT PIN A10-53.
TROUBLESHOOT METER DETECTOR CR1 AND CR2.
DOES SCOPE INDICATE ~ 2 V P-P AT 400 HZ AT A10-19 ?
YES
NO
AUDIO AMPLIFIER IS OPERATIONAL.
TROUBLESHOOT A10 U1B, A10U1C AND ASSOCIATED COMPONENTS.

Figure 4-16b. Audio Amplifier Troubleshooting Tree

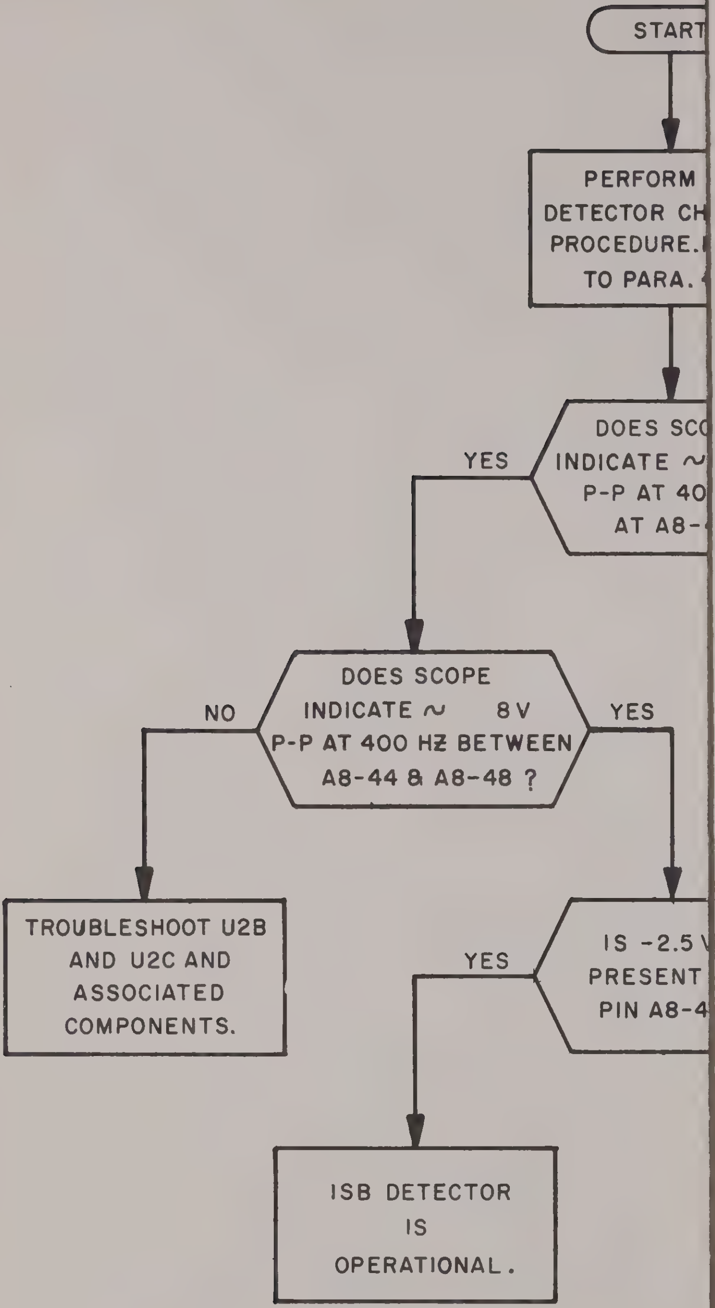


Figure 4-17a. ISB Detector/Audio

4.7 COMPONENT LEVEL TROUBLESHOOTING PROCEDURES

4.7.1 GENERAL

This section contains procedures for testing and repairing defective receiver PC boards to the component level. Checkout Procedures are provided to help identify fault symptoms and to verify PC board performance after repair. Troubleshooting Trees are provided to guide the technician in tracing signal flow through the module. A Parts Replacement Guide, paragraph 4.7.23, is included to assist the technician in repairing a defective PC board. In addition to using the Troubleshooting Trees, reference to circuit descriptions in Section III and schematic diagrams in Section VI is essential for efficient troubleshooting of the receiver.

4.7.2 PROCEDURE GUIDELINES

When testing or troubleshooting a PC board, observe the following:

1. Allow the test equipment a 30-minute warm-up.
2. Read the procedure before beginning a test.
3. After the repair, verify correct PC board operation by repeating the PC board Checkout Procedure.

4.7.3 POWER SUPPLY TESTING AND TROUBLESHOOTING

Power Supply Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Digital Voltmeter (Table 4-2) is required to perform the tests outlined below.

4.7.3.1 Power Supply Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.3.2 for fault isolation.

1. Deenergize the receiver.
2. Connect the common (-) Digital Voltmeter test lead to receiver ground terminal E4.
3. Connect the (+) Voltmeter test lead to the unregulated dc output at C8.
4. Set the Digital Voltmeter to the 200 Vdc range.
5. Energize the receiver. The Voltmeter should indicate at least +22 Vdc.
6. Deenergize the receiver.
7. Connect the (+) Voltmeter test lead to test point E1.

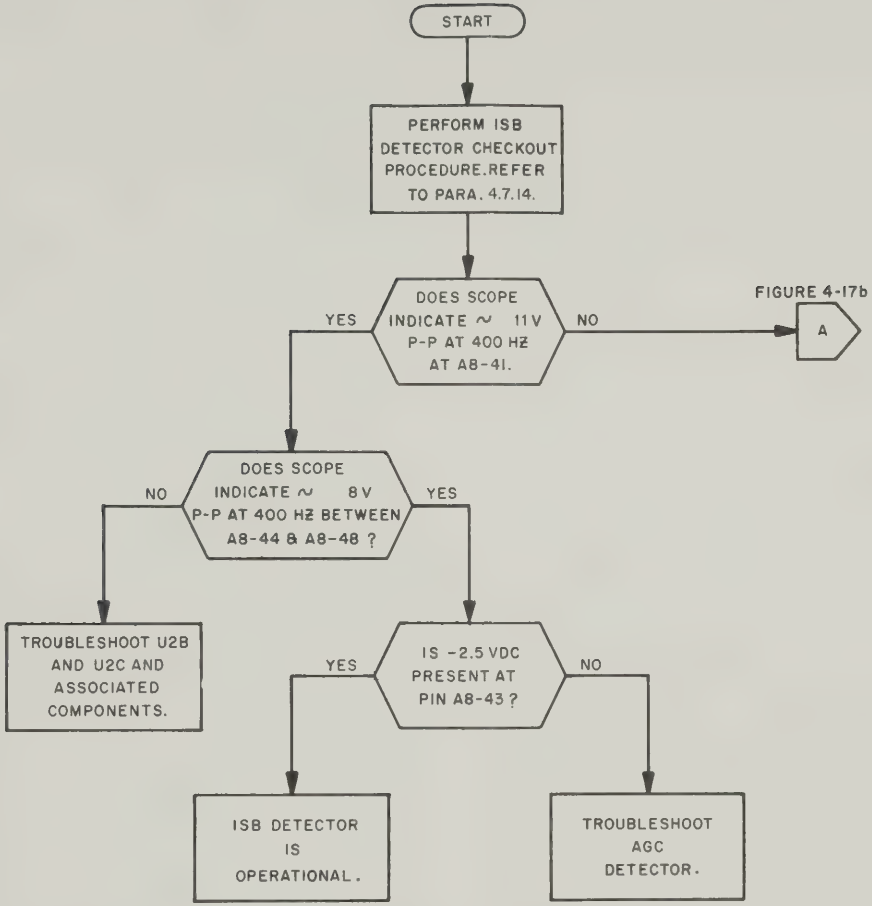

START
PERFORM ISB DETECTOR CHECKOUT PROCEDURE. REFER TO PARA. 4.7.14.
DOES SCOPE INDICATE ~ 11V P-P AT 400 HZ AT A8-41.
YES
NO
FIGURE 4-17b
A
DOES SCOPE INDICATE ~ 8V P-P AT 400 HZ BETWEEN A8-44 & A8-48 ?
NO
YES
TROUBLESHOOT U2B AND U2C AND ASSOCIATED COMPONENTS.
IS -2.5 VDC PRESENT AT PIN A8-43 ?
YES
NO
ISB DETECTOR IS OPERATIONAL.
TROUBLESHOOT AGC DETECTOR.

Figure 4-17a. ISB Detector/Audio Troubleshooting Tree

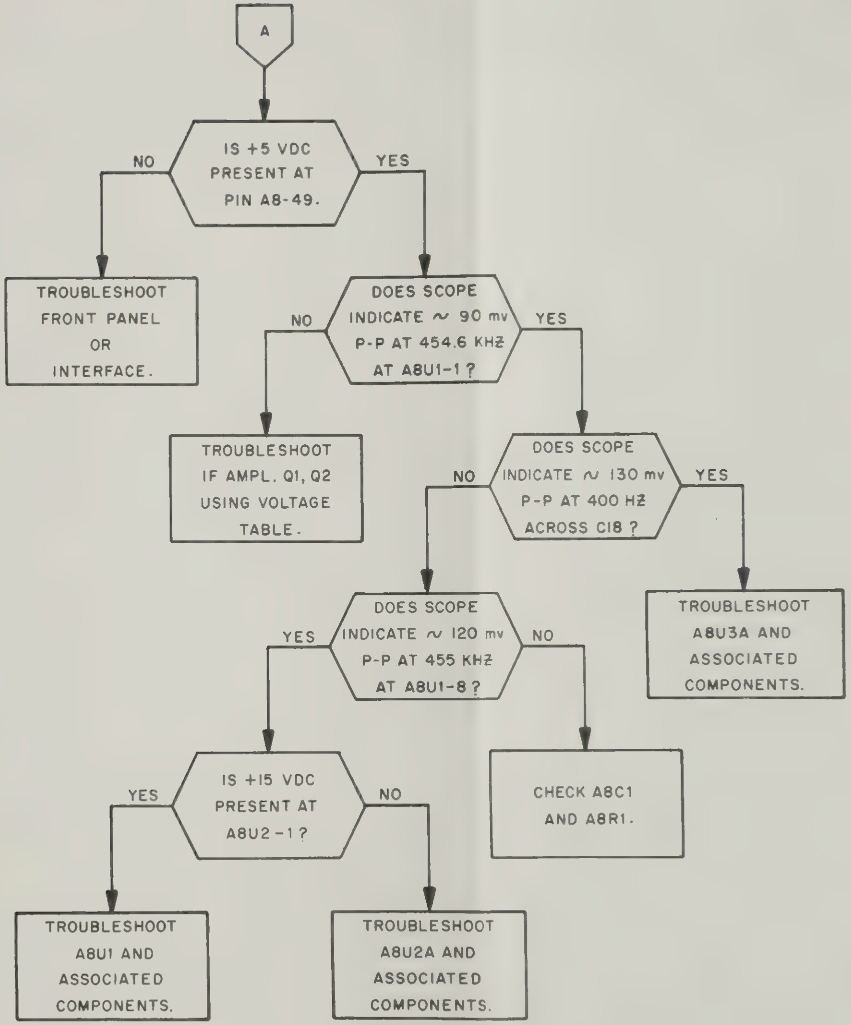

A
IS +5 VDC PRESENT AT PIN A8-49.
NO
YES
TROUBLESHOOT FRONT PANEL OR INTERFACE.
DOES SCOPE INDICATE ~ 90 mv P-P AT 454.6 KHZ AT A8U1-1 ?
NO
YES
TROUBLESHOOT IF AMPL. Q1, Q2 USING VOLTAGE TABLE.
DOES SCOPE INDICATE ~ 130 mv P-P AT 400 HZ ACROSS C18 ?
NO
YES
TROUBLESHOOT A8U3A AND ASSOCIATED COMPONENTS.
DOES SCOPE INDICATE ~ 120 mv P-P AT 455 KHZ AT A8U1-8 ?
YES
NO
CHECK A8C1 AND A8R1.
IS +15 VDC PRESENT AT A8U2-1 ?
YES
NO
TROUBLESHOOT A8U1 AND ASSOCIATED COMPONENTS.
TROUBLESHOOT A8U2A AND ASSOCIATED COMPONENTS.

Figure 4-17b. ISB Detector/Audio Troubleshooting Tree

4.7 COMPONENT LEVEL TROUBLESHOOTING PROCEDURES

4.7.1 GENERAL

This section contains procedures for testing and repairing defective receiver PC boards to the component level. Checkout Procedures are provided to help identify fault symptoms and to verify PC board performance after repair. Troubleshooting Trees are provided to guide the technician in tracing signal flow through the module. A Parts Replacement Guide, paragraph 4.7.23, is included to assist the technician in repairing a defective PC board. In addition to using the Troubleshooting Trees, reference to circuit descriptions in Section III and schematic diagrams in Section VI is essential for efficient troubleshooting of the receiver.

4.7.2 PROCEDURE GUIDELINES

When testing or troubleshooting a PC board, observe the following:

1. Allow the test equipment a 30-minute warm-up.
2. Read the procedure before beginning a test.
3. After the repair, verify correct PC board operation by repeating the PC board Checkout Procedure.

4.7.3 POWER SUPPLY TESTING AND TROUBLESHOOTING

Power Supply Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Digital Voltmeter (Table 4-2) is required to perform the tests outlined below.

4.7.3.1 Power Supply Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.3.2 for fault isolation.

1. Deenergize the receiver.
2. Connect the common (-) Digital Voltmeter test lead to receiver ground terminal E4.
3. Connect the (+) Voltmeter test lead to the unregulated dc output at C8.
4. Set the Digital Voltmeter to the 200 Vdc range.
5. Energize the receiver. The Voltmeter should indicate at least +22 Vdc.
6. Deenergize the receiver.
7. Connect the (+) Voltmeter test lead to test point E1.

8. Set the Voltmeter to the 20 Vdc range.
9. Energize the receiver. The Voltmeter should indicate +15 Vdc ±0.25 Vdc.
10. Deenergize the receiver.
11. Connect the (+) Voltmeter test lead to test point E2.
12. Energize the receiver. The Voltmeter should indicate -15 Vdc ±0.25 Vdc.
13. Deenergize the receiver.
14. Connect the (+) Voltmeter test lead to test point E3.
15. Energize the receiver. The Voltmeter should indicate at least +10 Vdc.
16. Deenergize the receiver and disconnect test equipment.

4.7.3.2 Power Supply Fault Isolation

The following list of Supplementary Troublshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the Power Supply for normal operation by repeating the Checkout Procedure in paragraph 4.7.3.1 above.

1.	Figure 4-7.	Power Supply Troubleshooting Tree
2.	Figure 6-22.	WJ-8718 Main Chassis Schematic Diagram
3.	Paragraph 3.5.	Power Supply Circuit Description
4.	Figure 5-5.	Power Distribution Location of Components
5.	Paragraph 4.7.23.	Parts Replacement Guidelines

* see addendum Jan 18, 1980

4.7.4 RF FILTER TESTING AND TROUBLESHOOTING

RF Filter Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator, and RF Voltmeter, and a Digital Voltmeter (see Table 4-2) are required to perform the tests outlined below.

4.7.4.1 RF Filter Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.4.2 for fault isolation.

1. Disconnect A2P1 from A3A1J1 on the Input Converter.

2. Connect an RF Voltmeter and 50 Ω adapter to A2P1.

3. Connect the output of a Signal Generator to A2J1 on the rear panel of the receiver.

4. Set the RF Voltmeter to the 0 dBm range.

5. Set the Signal Generator output frequency to 1.0 MHz and output level to 0 dBm.

6. The RF Voltmeter should indicate a level between 0 dBm and -1.0 dBm.

7. Tune the Signal Generator to 10 MHz and 20 MHz, and 30 MHz successively, maintaining the output level at 0 dBm for each frequency. The filter output level should not be less than -1.0 dBm for each frequency.

8. Disconnect the test equipment from the receiver.

9. Reconnect A2P1 to A3A1J1.

4.7.4.2 RF Filter Fault Isolation

1. Remove the filter from the receiver and remove the filter's protective cover.

2. Check all capacitors and the two Zener diodes for leakage to ground.

3. Check all inductors for continuity.

4. Excessive loss above 20 MHz may be corrected expanding or compressing some of the inductors.

4.7.5 INPUT CONVERTER TESTING AND TROUBLESHOOTING

Input Converter Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and a wideband Oscilloscope (see Table 4-2) are required to perform the tests outlined below.

4.7.5.1 Input Converter Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.5.2 for fault isolation.

1. Deenergize the receiver.

2. Disconnect A2P1 from A2A1J1 and P28 from A2A2J2.

3. Set the receiver front panel controls as follows:

   a. Gain Mode - Manual
   b. RF Gain - Maximum Clockwise

4. Connect the Oscilloscope to connector A3A2J2 using a short coaxial cable.

5. Connect the Signal Generator to connector A3A1J1 using a short coaxial cable. Set the Generator output frequency to 15.00500 MHz and output level to -10 dBm.

6. Energize the receiver and tune to 15.00500 MHz.

7. The Oscilloscope should display a level of ~3 V p-p at ~10.7 MHz. The waveform should be a clean sine wave.

8. Deenergize the receiver and disconnect test equipment.

4.7.5.2 Input Converter Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the Input Converter for normal operation by repeating the Checkout Procedure in paragraph 4.7.5.1 above.

1.	Figure 4-8.	Input Converter Troubleshooting Tree
2.	Table 4-4.	Input Converter Voltage Table
3.	Figure 6-2.	Input Converter Schematic Diagram
4.	Paragraph 3.2.3.	Input Converter Circuit Description
5.	Figure 5-7.	Input Converter Location of Components
6.	Paragraph 4.7.23.	Parts Replacement Guidelines
7.	Paragraph 4.8.3.1.	Input Converter Alignment

Table 4-4. Input Converter Voltage Table

TRANSISTOR PIN		VOLTAGE	TRANSISTOR PIN		VOLTAGE
A1Q1	E	+ 0.45	A2Q3	E	+ 8
	B	+ 1.1		B	+ 8.8
	C	+ 3.2		C	+ 14
A1Q2	S	+ 3.2	A2Q4	E	+ 1.25
	G	0.0		B	+ 1.95
	D	+ 15		C	+ 7

Table 4-4. Input Converter Voltage Table (Concluded)

TRANSISTOR PIN		VOLTAGE	TRANSISTOR PIN		VOLTAGE
A2Q1	E	+ 0.45	A2Q5	E	- 12
	B	+ 1.1		B	- 11
	C	+ 1.9		C	0.0
A2Q2	S	+ 1.95	A2Q6	E	- 10
	G	0.0		B	- 9.5
	D	+ 15		C	0.0
A2Q2	S	+ 1.95	A2Q6	E	- 10
	G	0.0		B	- 9.5
	D	+ 15		C	0.0

4.7.6 10.7 MHz FILTER SWITCH TESTING AND TROUBLESHOOTING

10.7 MHz Filter Switch Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and a wideband Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.6.1 10.7 MHz Filter Switch Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.6.2 for fault isolation.

1. Deenergize the receiver.
2. Disconnect connector P19 from A4XA1.
3. Remove PC board A4A2.
4. Depress the receiver 3.2 kHz BW button.
5. Connect the Oscilloscope to A4XA1 pin 57 using a short coaxial cable with clip leads on one end.
6. Connect the Signal Generator to A4XA1 pin 13 using a short coaxial cable with clip leads on one end. Set the Generator output frequency to 10.7 MHz and output level to -40 dBm.
7. Energize the receiver. The Oscilloscope should display a level of ~15 mV p-p at ~10.7 MHz. The waveform should be a clean sine wave.
8. Depress the 6 kHz BW button and then the 16 kHz BW button. The Oscilloscope should display ~15 mV p-p at ~10.7 MHz for both BW positions.

9. Deenergize the receiver and disconnect test equipment. Replace PC board A4A2.

4.7.6.2 10.7 MHz Filter Switch Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the 10.7 MHz Filter Switch for normal operation by repeating the Checkout Procedure in paragraph 4.7.6.1 above.

1.	Figure 4-9.	10.7 MHz Filter Switch Troubleshooting Tree
2.	Table 4-5.	10.7 MHz Filter Switch Voltage Table
3.	Figure 6-3.	10.7 MHz Filter Switch Schematic Diagram
4.	Paragraph 3.2.5.	10.7 MHz Filter Switch Circuit Description
5.	Figure 5-12.	10.7 MHz Filter Switch Location of Components
6.	Paragraph 4.7.23.	Parts Replacement Guidelines
7.	Paragraph 4.8.3.2.	10.7 MHz Filter Switch Adjustment

Table 4-5. 10.7 MHz Filter Switch Voltage Table

Bandwidth (kHz)				Bandwidth (kHz)			
PIN	16	6	3.2	PIN	16	6	3.2
Q1 1	14.7	14.7	14.4	Q4 1	14.9	14.8	14.9
2	0.0	0.0	4.6	2	0.0	4.6	0.0
3	1.0	1.0	1.4	3	0.94	0.8	0.94
4	1.1	1.1	1.9	4	1.4	1.99	1.4
Q2 1	14.9	14.9	14.8	Q5 1	14.7	14.7	14.7
2	0.0	0.0	4.6	2	4.3	0.0	0.0
3	1.0	1.0	0.6	3	0.9	1.0	1.0
4	1.4	1.4	1.4	4	1.1	1.0	1.0
Q3 1	14.8	14.6	14.8	Q6 1	14.8	14.9	14.9
2	0.0	4.6	0.0	2	4.4	0.0	0.0
3	0.9	1.0	0.9	3	0.75	1.0	1.0
4	0.9	1.4	0.9	4	0.75	1.0	1.0

4.7.7 10.7 MHz/455 kHz CONVERTER TESTING AND TROUBLESHOOTING

10.7 MHz/455 kHz Converter Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and a wideband Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.6.2a 10.7 MHz Filter Switch Fault Isolation (REVISION E)

The folowing list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the Fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the 10.7 MHz Filter Switch for normal operation by repeating the Checkout Procedure in paragraph 4.7.6.1 above.

1.	Figure 4-9	10.7 MHz Filter Switch Troubleshooting Tree
2.	Table 4-5a.	10.7 MHz Filter Switch Voltage Table
3.	Figure 6-3a	10.7 MHz Filter Switch Schematic Diagram
4.	Paragraph 3.2.5a	10.7 MHz Filter Switch Circuit Description
5.	Figure 5-12a	10.7 MHz Filter Switch Location of Components
6.	Paragraph 4.7.23.	Parts Replacement Guidelines
7.	Paragraph 4.8.3.2a	10.7 MHz Filter Switch Adjustment

Table 4-5a. 10.7 MHz Filter Switch (A4A1) Voltage Table

PIN		BANDWIDTH (kHz)			PIN		BANDWIDTH (kHz)		
		16	6.0	3.2			16	6.0	3.2
Q1	C	+15.26	+15.26	+14.50	Q4	C	+15.32	+15.32	+15.29
	B	- 2.38	- 2.38	+ 2.68		B	- 2.24	- 2.24	+ 2.48
	E	0.00	0.00	+ 2.04		E	0.00	0.00	+ 1.83
Q2	C	+15.26	+14.49	+15.26	Q5	C	+15.32	+15.29	+15.32
	B	- 2.53	+ 2.85	- 2.53		B	- 2.21	+ 2.44	- 2.21
	E	0.00	+ 2.19	0.00		E	0.00	+ 1.78	0.00
Q3	C	+15.17	+15.25	+15.26	Q6	C	+15.29	+15.32	+15.32
	B	+ 2.76	- 2.36	- 2.36		B	+ 2.50	- 2.23	- 2.23
	E	+ 2.01	0.00	0.00		E	+ 1.88	0.00	0.00

THIS PAGE LEFT BLANK

4.7.7.1 10.7 MHz/455 kHz Converter Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.7.2 for fault isolation.

1. Deenergize the receiver.
2. Remove PC boards A4A1, A4A3, A4A4, and A4A5.
3. Connect the Oscilloscope to A4XA2 pin 19 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane.
4. Connect the Signal Generator RF output to A4XA2 pin 57 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane. Set the Generator output frequency to 10.7 MHz and output level to -28 dBm.
5. Energize the receiver. The Oscilloscope should display a level of ~0.1 V p-p at ~455 kHz. The waveform should be a clean sine wave.
6. Deenergize the receiver and disconnect Test Equipment. Replace PC boards A4A1, A4A3, A4A4, and A4A5.

4.7.7.2 10.7 MHz/455 kHz Converter Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Data to isolate the fault to a stage or circuit and then trace the fault to a defective component or connection. After the fault has been corrected, check the 10.7 MHz/455 kHz Converter for normal operation by repeating the Checkout Procedure in paragraph 4.7.7.1 above.

1.	Table 4.6.	10.7 MHz/455 kHz Converter Voltage Table
2.	Figure 6-4.	10.7 MHz/455 kHz Converter Schematic Diagram
3.	Paragraph 3.2.6.	10.7 MHz/455 kHz Converter Circuit Description
4.	Figure 5-13.	10.7 MHz/455 kHz Converter Location of Components
5.	Paragraph 4.7.23.	General Parts Replacement Guide

Table 4-6. 10.7 MHz/455 kHz Converter Voltage Table

A2Q1	EMITTER	+ 3.24
	BASE	+ 3.96
	COLLECTOR	+14.8

4.7.8 455 kHz FILTER SWITCH TESTING AND TROUBLESHOOTING

455 kHz Filter Switch Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and a wideband Oscilloscope (Table 4-2) are required to perform the following tests.

4.7.8.1 455 kHz Filter Switch Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.8.2 for fault isolation.

1. Deenergize the receiver.
2. Remove PC boards A4A2, A4A4, A4A5, and A4A7.
3. Depress the receiver 16 kHz BW button.
4. Connect the Oscilloscope vertical input to A4XA3 pin 57 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane.
5. Connect the Signal Generator RF output to A4XA3 pin 13 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane. Set the Generator output frequency to 455 kHz and output level to -36 dBm.
6. Energize the receiver. The Oscilloscope should display a level of ~15 mV p-p at ~455 kHz. The waveform should be a clean sine wave.
7. Depress the 1.0 kHz BW button and then the 0.3 kHz BW button. The Oscilloscope should display a level of ~15 mV p-p at ~455 kHz for both BW positions.
8. Deenergize the receiver and disconnect test equipment. Replace PC boards A4A2, A4A4, A4A5, and A4A7.

4.7.8.2 455 kHz Filter Switch Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the 455 kHz Filter Switch for normal operation by repeating the Checkout Procedure in paragraph 4.7.8.1 above.

1.	Figure 4-10	455 kHz Filter Switch Troubleshooting Tree
2.	Table 4-7	455 kHz Filter Switch Voltage Table
3.	Figure 6-5	455 kHz Filter Switch Schematic Diagram
4.	Paragraph 3.2.7	455 kHz Filter Switch Circuit Description

5. Figure 5-14 455 kHz Filter Switch Location of Components
6. Paragraph 4.7.23. Parts Replacement Guidelines

Table 4-7. 455 kHz Filter Switch Voltage Table

BANDWIDTH (kHz)				
	PIN	16/6/3.2	1.0	0.3
U1	1	- 12.9	+ 13.5	- 12.9
	3	0.0	+ 4.6	0.0
	5	+ 4.4	0.0	0.0
	7	+ 13.6	- 13	- 13
	11	- 14	- 14	- 14
	12	0.0	0.0	+ 4.6
	13	+ 2.7	+ 2.7	+ 2.7
	14	- 13	- 13	+ 13.6
Q1	E	0.0	0.0	0.0
	B	- 1.8	- 1.8	+ 1.8
	C	+ 14.9	+ 14.9	+ 14.9
Q2	E	0.0	0.0	+ 0.9
	B	- 1.5	- 1.5	+ 1.5
	C	14	14	14
Q3	E	0.0	+ 2.3	0.0
	B	- 3	+ 3	- 3
	C	14.9	14.3	14.8
Q4	E	0.0	0.8	0.0
	B	- 1.4	+ 1.4	- 1.4
	C	14	14	14
Q5	E	1.25	0.0	0.0
	B	+ 1.9	- 1.9	- 1.9
	C	+ 14.7	+ 14.7	+ 14.7
Q6	E	+ 0.8	0.0	0.0
	B	+ 1.4	- 1.4	- 1.4
	C	+ 14	+ 14	+ 14

4.7.9 USB FILTER SWITCH TESTING AND TROUBLESHOOTING

USB Filter Switch Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and a wideband Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.9.1 USB Filter Switch Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.9.2 for fault isolation.

1. Deenergize the receiver.
2. Remove PC boards A4A2, A4A3, A4A5, and A4A7.
3. Connect the Oscilloscope Vertical Input to A4XA4 pin 57 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane.
4. Connect the Signal Generator RF output to A4XA4 pin 13 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane. Set the Generator output frequency to 456.5 kHz and output level to -36 dBm.
5. Energize the receiver and depress the USB Mode button. The Oscilloscope should display a level of ~200 mV p-p at ~456.5 kHz. The waveform should be a clean sine wave.
6. Deenergize the receiver and disconnect test equipment.
7. Replace PC boards A4A2, A4A3, A4A5, and A4A7.

4.7.9.2 USB Filter Switch Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the USB Filter Switch for normal operation by repeating the Checkout Procedure in paragraph 4.7.9.1 above.

1.	Figure 4-11.	USB Filter Switch Troubleshooting Tree
2.	Table 4-8.	USB Filter Switch Voltage Table
3.	Figure 6-6.	USB Filter Switch Schematic Diagram
4.	Paragraph 3.2.8.	USB Filter Switch Location of Components
5.	Paragraph 4.7.23.	Parts Replacement Guidelines
6.	Paragraph 4.8.3.5.	USB Filter Switch Adjustment

4.7.9.2a USB Filter Switch Fault Isolation (REVISION G)

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the USB Filter Switch for normal operation by repeating the Checkout Procedure in paragraph 4.7.9.1 above.

1.	Figure 4-11	USB Filter Switch Troubleshooting Tree
2.	Table 4-8a.	USB Filter Switch Voltage Table
3.	Figure 6-6a.	USB Filter Switch Schematic Diagram
4.	Paragraph 3.2.8a.	USB Filter Switch Location of Components
5.	Paragraph 4.7.23.	Parts Replacement Guidelines
6.	Paragraph 4.8.3.5a.	USB and ISB/LSB Filter Switch Adjustment

THIS PAGE LEFT BLANK

Table 4-8. USB Filter Switch Voltage Table

PIN		USB MODE ACTIVE	OTHER MODES ACTIVE
Q1	1	+ 14.5	+ 15
	2	+ 4.2	0
	3	+ 2	+ 2
	4	+ 2.7	+ 2
Q2	1	+ 14.6	+ 15
	2	+ 4.3	0
	3	+ 1.7	+ 1.4
	4	+ 3.2	+ 2

4.7.10 ISB/LSB FILTER SWITCH TESTING AND TROUBLESHOOTING

ISB/LSB Filter Switch Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and a wideband Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.10.1 ISB/LSB Filter Switch Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.10.2 for fault isolation.

1. Deenergize the receiver.
2. Remove PC boards A4A2, A4A2, A4A4, A4A7, and A4A8.
3. Connect the Oscilloscope Vertical Input to A4XA5 pin 57 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane.
4. Connect the Signal Generator RF output to A4XA5 pin 13 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane. Set the Generator output frequency to 453.5 kHz and output level to -36 dBm.
5. Energize the receiver and depress the LSB Mode button. The Oscilloscope should display a level of ~200 mV p-p at ~453.5 kHz. The waveform should be a clean sine wave.
6. Move the Oscilloscope clip lead to pin A4XA5-53 and depress the ISB Mode button. The Oscilloscope should display a level of ~200 mV p-p at ~453.5 kHz.
7. Deenergize the receiver and disconnect test equipment.
8. Replace PC boards A4A2, A4A3, A4A4, A4A7, and A4A8.

Table 4-8a. USB Filter Switch (A4A4) Voltage Table (Revision G)

Pin		USB Mode	Other Mode
Q1	C	+14.69	+15.38
	B	+ 2.34	- 2.15
	E	+ 1.68	0.00
Q2	C	+14.78	+15.38
	B	+ 1.80	- 1.76
	E	+ 1.14	0.00

THIS PAGE LEFT BLANK

4.7.10.2 ISB/LSB Filter Switch Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the ISB/LSB Filter Switch for normal operation by repeating the Checkout Procedure in paragraph 4.7.10.1 above.

1.	Figure 4-12.	ISB/LSB Filter Switch Troubleshooting Tree
2.	Table 4-9.	ISB/LSB Filter Switch Voltage Table
3.	Figure 6-7.	ISB/LSB Filter Switch Option Schematic Diagram
4.	Paragraph 3.2.9.	ISB/LSB Filter Switch Option Circuit Description
5.	Figure 5-16.	ISB/LSB Filter Switch Option Location of Components
6.	Paragraph 4.7.23.	Parts Replacement Guidelines
7.	Paragraph 4.8.3.5.	ISB/LSB Filter Switch Adjustment

Table 4-9. ISB/LSB Filter Switch Voltage Table

	PIN	LSB MODE ACTIVE	ISB MODE ACTIVE	OTHER MODES ACTIVE
Q1	1	+ 14.4	+ 14.4	+ 15
	2	+ 4.2	+ 4.2	0.0
	3	+ 2.2	+ 2.2	+ 2.0
	4	+ 2.7	+ 2.7	+ 2.0
Q2	1	+ 14.6	+ 15	+ 15
	2	+ 4.2	0.0	0.0
	3	+ 1.6	+ 1.3	+ 1.3
	4	+ 2.9	+ 2.0	+ 2.0
Q3	1	+ 15	+ 14.7	+ 15
	2	0.0	+ 4.2	0.0
	3	+ 1.4	+ 1.6	+ 1.4
	4	+ 2.0	+ 2.8	+ 2.0

4.7.11 455 kHz AMPLIFIER/AM DETECTOR TESTING AND TROUBLESHOOTING

455 kHz Amplifier/AM Detector Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and a wideband Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.10.2a ISB/LSB Filter Switch Fault Isolation (REVISION E)

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the ISB/LSB Filter Switch for normal operation by repeating the Checkout Procedure in paragraph 4.7.10.1 above.

1.	Figure 4-12.	ISB/LSB Filter Switch Troubleshooting Tree
2.	Table 4-9a.	ISB/LSB Filter Switch Voltage Table
3.	Figure 6-7a.	ISB/LSB Filter Switch Option Schematic Diagram
4.	Paragraph 3.2.9a.	ISB/LSB Filter Switch Option Circuit Description
5.	Figure 5-16a.	ISB/LSB Filter Switch Option Location of Components
6.	Paragraph 4.7.23.	Parts Replacement Guidelines
7.	Paragraph 4.8.3.5a	USB and ISB/LSB Filter Switch Adjustment

Table 4-9a ISB/LSB Filter Switch (A4A5) Voltage Table

Pin		LSB Mode	ISB Mode	Other Mode
Q1	C	+14.65	+14.67	+15.37
	B	+ 2.18	+ 2.19	- 1.26
	E	+ 1.53	+ 1.54	0.00
Q2	C	+14.57	+15.02	+15.37
	B	+ 2.25	- 2.21	- 2.18
	E	+ 1.59	0.00	0.00
Q3	C	+14.99	+14.64	+15.37
	B	- 2.23	+ 2.11	- 2.21
	E	0.00	+ 1.45	0.00

THIS PAGE LEFT BLANK

4.7.11.1 455 kHz Amplifier/AM Detector Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.11.2 for fault isolation.

1. Deenergize the receiver.
2. Remove the PC boards.
3. Connect the Oscilloscope Vertical Input to A4XA7 pin 17 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane.
4. Connect the Signal Generator RF output to A4XA7 pin 57 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane. Set the Generator output frequency to 455 kHz and output level to -74 dBm.
5. Energize the receiver. The Oscilloscope should display a level of ~60 mV p-p at ~455 kHz. The waveform should be a clean sine wave.
6. Move the Oscilloscope clip lead to A4XA7 pin 13. The Oscilloscope should display a level of ~60 mV p-p at ~455 kHz.
7. Turn on the Signal Generator AM Modulation and set it for 50% modulation at 400 Hz.
8. Move the Oscilloscope clip lead to A4X47 pin 51. The Oscilloscope should display a level of ~0.3 V p-p at ~400 Hz. The waveform should be a clean sine wave.
9. Deenergize the receiver and disconnect test equipment.
10. Replace PC boards A4A3, A4A6, A4A9, and A4A10.

4.7.11.2 455 kHz Amplifier/AM Detector Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the 455 kHz Amplifier/AM Detector for normal operation by repeating the Checkout Procedure in paragraph 4.7.11.1 above.

1.	Figure 4-13.	455 kHz Amplifier/AM Detector Troubleshooting Tree
2.	Table 4-10.	455 kHz Amplifier/AM Detector Voltage Table
3.	Figure 6-9.	455 kHz Amplifier/AM Detector Schematic Diagram
4.	Paragraph 3.2.10.	455 kHz Amplifier/AM Detector Circuit Description

5. Figure 5-18. 455 kHz Amplifier/AM Detector Location of Components
6. Paragraph 4.7.23. Parts Replacement Guidelines
7. Paragraph 4.8.3.3. 455 kHz Amplifier/AM Detector Response Alignment
8. Paragraph 4.8.3.4. 455 kHz Amplifier/AM Detector Gain Adjustment

Table 4-10. 455 kHz Amplifier/AM Detector Voltage Table

PIN		VOLTAGE	PIN		VOLTAGE
Q1	1	+ 13.7	Q4	E	+ 3.5
	2	+ 3.75		B	+ 4.1
	3	+ 0.87		C	+ 14.4
	3	+ 0.87		C	+ 14.4
	4				
Q2	1	+ 15	Q5	E	- 0.7
	2	+ 3.8		B	- 0.1
	3	+ 0.9		C	+ 14.2
	4	+ 1.4			
Q3	E	- 0.5	Q6	E	+ 3.3
	B	0.0		B	+ 0.95
	C	+ 15.0		C	+ 15.0

NOTE

Above readings taken in Fast-AGC Mode with no RF input signal.

4.7.12 FM/CW/SSB DETECTOR TESTING AND TROUBLESHOOTING

FM/CW/SSB Detector Testing and Troubleshooting includes a CW/SSB Detector Checkout Procedure, an FM Detector Checkout Procedure and fault isolation information. A Signal Generator and a wideband Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.12.1 CW/SSB Detector Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.12.3 for fault isolation.

1. Deenergize the receiver.
2. Remove PC boards A4A7 and A4A10.

3. Connect the Oscilloscope Vertical Input to A4XA9 pin 57 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane.

4. Connect the Signal Generator RF output to A4X49 pin 13 using a short coaxial cable with clip leads on one end. Connect cable shield to the ground plane. Set the Generator output frequency to 455.4 kHz and output level to -28 dBm.

5. Energize the receiver and depress the USB Mode button. The Oscilloscope should display a level of ~2 V p-p at ~400 Hz. The waveform should be a clean sine wave.

6. Deenergize the receiver and diconnect test equipment.

7. Replace PC boards A4A7 and A4A10 if no further checks are to be made.

4.7.12.2 FM Detector Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.12.3 for fault isolation.

1. Deenergize the receiver.

2. Remove PC boards A4A7 and A4A10.

3. Connect the Oscilloscope Vertical Input to A4XA9 pin 57 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane.

4. Connect the Signal Generator RF output to A4XA9 pin 13 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane. Set the generator output frequency to 455 kHz and output level to -28 dBm. Set the Generator for FM Modulation at 400 Hz and 4.8 kHz deviation.

5. Energize the receiver and depress the FM Mode button. The Oscilloscope should display a level of ~1 V p-p at ~400 Hz. The waveform should be a clean sine wave.

6. Deenergize the receiver and disconnect test equipment.

7. Replace PC boards A4A7 and A4A10 if no further checks are to be made.

4.7.12.3 FM/CW/SSB Detector Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the FM/CW/SSB Detector for normal operation by repeating the Checkout Procedure in paragraphs 4.7.12.1 and 4.7.12.2 above.

1.	Figure 4-14.	CW/SSB Detector Troubleshooting Tree
2.	Figure 4-15.	FM Detector Troubleshooting Tree
3.	Table 4-11.	FM/CW/SSB Detector Voltage Table
4.	Figure 6-11.	FM/CW/SSB Detector Schematic Diagram
5.	Paragraph 3.2.12.	FM/CW/SSB Detector Circuit Description
6.	Figure 5-20.	FM/CW/SSB Detector Location of Components
7.	Paragraph 4.7.23.	Parts Replacement Guidelines
8.	Paragraph 4.8.3.7.	FM Discriminator Alignment

Table 4-11. FM/CW/SSB Detector Voltage Table

Component Pin	AM	FM	CW & SB
Q1 E	9.6	8.1	9.2
Q1 B	9.5	7.3	9.2
Q1 C	0.0	8.0	0.0
Q2 E	0.0	2.0	0.0
Q2 B	0.0	0.62	0.0
Q2 C	9.9	0.0	9.2
Q3 E	9.6	8.7	9.0
Q3 B	9.6	8.7	8.4
Q3 C	-1.8	-1.8	9.0
Q4 E	0.0	0.0	0.0
Q4 B	0.0	0.0	0.7
Q4 C	9.6	8.8	0.0
U1 1	0.0	2.0	0.0
U1 2	0.0	2.0	0.0
U1 3	0.0	2.0	0.0
U1 4	0.0	2.0	0.0
U1 5	0.0	5.6	0.0
U1 6	0.0	0.0	0.0
U1 7	0.0	0.0	0.0
U1 8	0.0	0.0	0.0
U1 9	0.0	0.8	0.0
U1 10	0.0	5.6	0.0

Component Pin	AM	FM	CW & SB
U2 1	- 1.6	- 1.6	- 1.6
U2 3	- 1.7	- 1.7	- 1.7
U2 4	- 1.6	- 1.6	- 1.6
U2 5	- 3.8	- 3.8	- 3.8
U2 6	- 0.7	- 0.7	3.8
U2 7	0.0	0.0	0.0
U2 8	- 0.1	- 0.1	0.0
U2 9	- 0.0	0.0	0.0
U2 12	- 0.7	- 0.7	4.0
U2 13	- 0.7	- 0.7	4.0
U2 14	-13.0	-13.0	-13.0
U3 1	0.0	0.3	0.0
U3 2	0.0	0.63	0.0
U3 3	0.0	0.64	0.0
U3 4	14.0	12.5	13.5
U3 5	0.0	0.0	0.0
U3 6	0.0	0.0	0.0
U3 7	0.0	0.0	0.0
U3 8	0.0	- 0.0	0.0
U3 9	0.0	0.0	0.0
U3 10	0.0	0.0	0.0
U3 11	-13.0	-13.0	-13.0
U3 12	9.4	8.5	9.1
U3 13	9.4	8.5	9.1

4.7.13 AUDIO AMPLIFIER TESTING AND TROUBLESHOOTING

Audio Amplifier Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and an Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.13.1 Audio Amplifier Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.13.2 for fault isolation.

1. Deenergize the receiver.
2. Remove PC boards A4A6, A4A7, and A4A9.
3. Set the receiver Line Audio Level control to mid-range and the Phone Level control to Maximum Clockwise.
4. Connect the Oscilloscope Vertical Input to A4XA10 pin 55 using a short coaxial cable with clip leads on one end. Connect shield to IF Motherboard ground plane.
5. Connect the Signal Generator AM output to A4XA10 pin 51 using a short coaxial cable with clip leads on one end. Connect cable shield to IF Motherboard ground plane. Set the Signal Generator Modulation Frequency to 400 Hz, set Audio Output Level to 1.0 V rms and set AM switch to INT.
6. Energize the receiver and depress the AM Mode button. The Oscilloscope should display a level of ~2 V p-p at ~400 Hz. The waveform should be a clean sine wave.
7. Set the Generator Audio Output Level to 10 mV. Move the Generator clip lead to A4XA10 pin 17. Use the Oscilloscope lead to probe A4XA10 pin 13 and A4XA10 pin 11. The Oscilloscope should display a level of ~2 V p-p at ~400 Hz on each pin.
8. Connect the Oscilloscope clip lead to A4XA10 pin 41. The Oscilloscope should indicate a level of -0.3 Vdc.
9. Set the Generator Audio Output Level to 0.1 V. Move the Generator clip lead to A4XA10 pin 53. Move the Oscilloscope clip lead to A4XA10 pin 19. The Oscilloscope should display a level of ~2 V p-p at ~400 Hz.
10. Deenergize the receiver and disconnect test equipment.
11. Replace PC boards A4A6, A4A7, and A4A9.

4.7.13.2 Audio Amplifier Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other

Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the Audio Amplifier for normal operation by repeating the Checkout Procedure in paragraph 4.7.13.1 above.

1.	Figure 4-16.	Audio Amplifier Troubleshooting Tree
2.	Table 4-12.	Audio Amplifier Voltage Table
3.	Figure 6-12.	Audio Amplifier Schematic Diagram
4.	Paragraph 3.2.13.	Audio Amplifier Circuit Description
5.	Figure 5-21.	Audio Amplifier Location of Components
6.	Paragraph 4.7.23.	Parts Replacement Guidelines

Table 4-12. Audio Amplifier Voltage Table

	PIN	AM MODE ACTIVE	OTHER MODES ACTIVE
Q1	S	0.0	0.0
	D	0.0	0.0
	G	0.0	- 13
Q2	E	+ 22	+ 22
	B	+ 22.5	+ 22.5
	C	+ 23	+ 23
U1	1	+ 14	- 14
	2	+ 1.6	+ 1.6
	3	+ 5	0.0
U2	2	+ 11	+ 11
	13	+ 11	+ 11

4.7.14 ISB DETECTOR/AUDIO TESTING AND TROUBLESHOOTING

ISB Detector/Audio Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and an Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.14.1 ISB Detector/Audio Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.14.2 for fault isolation.

1. Deenergize the receiver.
2. Remove PC boards A4A5 and A4A6.

3. Connect the Oscilloscope Vertical Input to A4XA8 pin 41 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane.

4. Connect the Signal Generator RF output to A4XA8 pin 53 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane. Set the Generator output frequency to 454.6 kHz and output level to -46 dBm.

5. Energize the receiver and depress the ISB Mode button. The Oscilloscope should display a level of ~11 V p-p at ~400 Hz. The waveform should be a clean sine wave.

6. Move the Oscilloscope clip lead to A4XA8 pin 44. Move shield clip lead to A4XA8 pin 48. Adjust 48R36 for an Oscilloscope reading of ~8 V p-p at ~400 Hz. The waveform should be a clean sine wave.

7. Move the Oscilloscope clip lead to A4XA8 pin 43. Connect cable shield to IF Motherboard ground plane. The Oscilloscope should display ~0.0 Vdc.

8. Increase the Generator output level by 10 dBm. The level displayed on the Oscilloscope should increase to ~ -2.5 Vdc.

9. Deenergize the receiver and disconnect the test equipment.

10. Replace PC boards A4A5 and A4A6.

4.7.14.2 ISB Detector/Audio Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the ISB Detector/Audio board for normal operation by repeating the Checkout Procedure in paragraph 4.7.14.1 above.

1.	Figure 4-17a, b.	ISB Detector/Audio Troubleshooting Tree
2.	Table 4-13.	ISB Detector/Audio Voltage Table
3.	Figure 6-10.	ISB Detector/Audio Schematic Diagram
4.	Paragraph 3.2.14.	ISB Detector/Audio Circuit Description
5.	Figure 5-19.	ISB Detector/Audio Location of Components
6.	Paragraph 4.7.23.	Parts Replacement Guidelines
7.	Paragraph 4.8.3.6.	ISB Detector/Audio Adjustment

Table 4-13. ISB Detector/Audio Voltage Table

	PIN	ISB	OTHER MODES
U1	1	- 7.5	- 7.5
	4	- 7	- 7
	5	- 13.5	- 13.5
	6	+ 1.3	- 0.8
	12	+ 1	- 0.8
	14	+ 15	+ 15
U2	1	+ 14	- 13.5
	2	+ 1.5	+ 1.5
	3	+ 5	0.0
	4	+ 15	+ 15
	11	- 15	- 15
	12	0.0	0.0
	13	+ 1	+ 5
	14	+ 1	+ 5
U3	4	+ 15	+ 15
	8	0.0	0.0
	9	0.0	0.0
	10	0.0	0.0
	11	- 15	- 15
	12	0.0	0.0
	13	0.0	0.0
	14	0.0	0.0

	PIN	ISB	OTHER MODES
Q1	1	+ 14.5	+ 14.5
	2	+ 3.3	+ 3.3
	3	+ 0.9	+ 0.9
	4	+ 1	+ 1
Q2	1	+ 14	+ 14
	2	+ 3.3	+ 3.3
	3	+ 0.8	+ 0.8
	4	+ 1	+ 1
Q3	E	0.0	+ 7.5
	B	+ 0.2	+ 0.2
	C	0.0	0.0
Q4	E	0.0	0.0
	B	0.0	0.0
	C	+ 15	+ 15
Q5	E	0.0	0.0
	B	+ 2.8	- .5
	C	0.0	0.0

4.7.15 AGC TESTING AND TROUBLESHOOTING

AGC Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and a Digital Voltmeter (Table 4-2) are required to perform the tests outlined below.

4.7.15.1 AGC Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.15.2 for fault isolation.

1. Deenergize the receiver.

2. Remove PC boards A4A3, A4A4, A4A5, and A4A10.

3. Set the receiver Gain Mode to Fast AGC and Meter switch to Line Audio.

4. Connect the Digital Voltmeter input to A4XA6 pin 47 using a short cable with clip leads on one end. Connect the common lead to the IF Motherboard ground plane. Set the Digital Voltmeter to the 20 Vdc range.

5. Connect the Signal Generator output to A4XA7 pin 57 using a short coaxial cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane. Set the Generator output frequency to 455 kHz and output level to -40 dBm.

6. Energize the receiver. The Digital Voltmeter should indicate ~ -3.5 Vdc.

7. Select the receiver MAN Gain Mode. Adjust the RF Gain control until the Digital Voltmeter indicates the same level indicated in step 7.

8. Select the Fast AGC Mode.

9. Connect the Digital Voltmeter clip lead to A4XA6 pin 19. The Voltmeter should indicate ~+0.7 Vdc.

10. Connect the Digital Voltmeter clip lead to A4XA6 pin 41. The Voltmeter should indicate ~-3.0 Vdc.

11. Deenergize the receiver and disconnect test equipment.

12. Replace PC boards A4A3, A4A4, A4A5, and A4A10.

4.7.15.2 AGC Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Data to isolate the fault to a stage or circuit and then to trace the fault to a defective component or connection. After the fault has been corrected, check the AGC board for normal operation by repeating the Checkout Procedure in paragraph 4.7.15.1 above.

1.	Table 4-14.	AGC Voltage Table
2.	Figure 6-8.	AGC Schematic Diagram
3.	Paragraph 3.2.11.	AGC Circuit Description
4.	Figure 5-17.	AGC Location of Components
5.	Paragraph 4.7.23.	Parts Replacement Guidelines

Table 4-14. AGC Voltage Table

TRANSISTOR		INPUT SIGNAL			NO SIGNAL		
		MAN	SLOW	FAST	MAN	SLOW	FAST
Q1	E	1.7	2.2	2.2	0.05	0.06	0.06
	B	2.0	2.6	2.6	+ 0.4	0.38	0.38
	C	14.3	14.3	14.4	14.4	14.3	14.4

Table 4-14. AGC Voltage Table (Cont'd)

TRANSISTOR		INPUT SIGNAL			NO SIGNAL		
		MAN	SLOW	FAST	MAN	SLOW	FAST
Q2	E	0.77	0.77	0.77	0.06	0.06	0.06
	B	0.18	0.20	0.20	0.02	0.2	0.02
	C	0.0	0.13	0.13	0.0	0.0	0.0
Q3	E	0.0	0.0	0.0	0.0	0.0	0.0
	B	0.6	0.0	0.0	0.59	0.0	0.0
	C	0.0	0.0	0.0	0.01	0.0	0.0
Q4	E	0.0	0.0	0.0	0.0	0.0	0.0
	B	- 2.3	- 2.3	- 2.3	- 2.3	- 2.3	- 2.3
	C	- 0.06	- 0.6	- 0.6	0.0	0.0	0.0
Q5	E	- 2.9	- 2.8	- 2.8	- 0.50	0.07	0.07
	B	- 2.3	- 2.3	- 2.3	- 2.3	- 2.3	- 2.3
	C	- 0.6	- 0.6	- 0.6	0.0	0.0	0.0
Q6	E	0.0	0.0	0.0	0.0	0.0	
	B	0.58	0.0	0.54	0.0	0.0	
	C	0.05	0.13	0.13	0.01	0.0	0.0
Q7	E	0.0	0.0	0.0	0.0	0.0	0.0
	B	- 3.9	0.62	- 3.9	- 3.9	0.63	- 3.9
	C	N/A	N/A	N/A	N/A	N/A	N/A
U1	1	2.0	2.2	2.2	0.06	0.07	0.07
	2	2.0	2.2	2.2	0.06	0.07	0.07
	3	2.0	2.2	2.2	0.05	0.06	0.05
	4	14.3	14.3	14.4	14.4	14.3	14.4
	5	0.0	5.0	0.0	0.0	5.0	0.0
	6	1.5	1.7	1.7	1.7	1.7	1.7
	7	- 12.6	12.9	- 12.6	- 12.9	12.9	- 12.6
	8	- 2.0	- 2.2	- 2.2	- 0.05	- 0.05	- 0.05
	9	0.0	0.0	0.0	0.0	0.0	0.0
	10	0.0	0.0	0.0	0.0	0.0	0.0
	11	- 13.8	- 13.8	- 13.8	- 13.8	- 13.9	- 13.8
	12	- 3.6	- 3.6	- 3.6	- 0.5	0.07	0.07
	13	- 3.6	- 3.6	- 3.6	- 0.5	0.07	0.07
	14	- 3.6	- 3.6	- 3.6	- 0.5	0.07	0.07
U2	1	0.86	0.82	0.83	- 0.08	- 0.08	- 0.08
	2	0.86	0.82	0.83	- 0.08	- 0.8	- 0.8
	3	0.86	0.82	0.83	- 0.08	- 0.08	- 0.08
	4	14.3	14.4	14.4	14.3	14.3	
	5	0.0	0.0	0.0	0.0		
	6	0.0	0.0	0.0	0.0	0.0	0.0
	7	- 6.6	- 6.5	- 6.5	- 0.8	0.12	0.12

Table 4-14. AGC Voltage Table (Concluded)

TRANSISTOR	INPUT SIGNAL			NO SIGNAL		
	MAN	SLOW	FAST	MAN	SLOW	FAST
8	- 0.25	- 0.24	- 0.24	0.03	0.03	0.03
9	- 0.05	- 0.06	0.0	0.0	0.0	
10	- 0.06	- 0.06	- 0.06	0.0	0.0	0.0
11	- 13.8	- 13.8	- 13.8	- 13.8	- 13.9	- 13.8
12	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
14	0.85	0.82	0.8	0.0	0.0	0.0

NOTE

Two sets of data are given: one with an input signal and one without. When using the input signal data, tune the receiver to 15.00500 MHz and inject an unmodulated signal of 15.00500 MHz at -40 dBm into RF Input jack A2J1. Nominal voltage values are given for each of the three gain modes: Manual, Fast AGC, and Slow AGC. The RF Gain Control must be set maximum clockwise while using Manual Mode No Signal data. To use data for Manual Mode with Input Signal, reduce gain control setting to achieve the same meter reading as in AGC Mode.

4.7.16 FRONT PANEL INTERCONNECT TESTING AND TROUBLESHOOTING

Front Panel Interconnect Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Digital Voltmeter (Table 4-2) is required to perform the tests outlined below.

4.7.16.1 Front Panel Interconnect Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.16.2 for fault isolation.

1. Deenergize the receiver.
2. Connect the common (-) input of the Digital Voltmeter to A6XA2 pin 5 using a short test lead.
3. Energize the receiver.
4. Refer to Table 4-15 and depress the indicated Mode and BW pushbuttons in succession. For each Mode or BW selected, use the Digital Voltmeter positive (+) test lead to probe for high (> 2.5 Vdc) or low (< 0.5 Vdc) conditions as indicated.
5. Deenergize the receiver and disconnect test equipment.

Table 4-15. Front Panel Interconnect Voltage Table

Pin Nos.	AM	CW	FM	USB	LSB	ISB
A6XA2-5	LO	LO	LO	LO	HI	LO
A6XA2-3	LO	LO	LO	HI	LO	LO
A6XA2-1	LO	LO	LO	LO	LO	HI
A6XA2-18	LO	HI	LO	HI	HI	HI
A6XA2-16	LO	LO	HI	LO	LO	LO
A6XA2-48	HI	LO	LO	LO	LO	LO
A6XA2-58	HI	HI	HI	LO	LO	LO
A6XA2-60	HI	LO	HI	LO	LO	LO
A10J1-22	HI	HI	HI	LO	LO	LO
A10J1-37	HI	HI	HI	LO	LO	LO
A10J1-16	HI	HI	HI	LO	LO	LO

Pin Nos.	16 kHz	6 kHz	3 kHz	1 kHz	.3 kHz	USB/LSB/ISB
A6XA2-49	HI	HI	HI	LO	LO	LO
A6XA2-51	HI	LO	LO	HI	HI	HI
A6XA2-53	LO	HI	LO	LO	LO	LO
A6XA2-55	LO	LO	HI	LO	LO	LO
A6XA2-47	LO	LO	LO	HI	LO	LO
A6XA2-45	LO	LO	LO	LO	HI	LO

4.7.16.2 Front Panel Interconnect Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in Fault Isolation. Use the Troubleshooting Tree to isolate the fault to a stage or circuit. Use the other Troubleshooting Data to trace the fault to a defective component or connection. After the fault has been corrected, check the Front Panel Interconnect for normal operation by repeating the Checkout Procedure in paragraph 4.7.16.1 above.

1. Figure 6-23. WJ-8718 Main Chassis
2. Paragraph 3.4.2. Front Panel Interconnect Circuit Description
3. Figure 5-31. Front Panel Interconnect Location of Components
4. Paragraph 4.7.23. Parts Replacement Guidelines

4.7.17 LOWER PANEL CONTROL TESTING AND TROUBLESHOOTING

Lower Panel Control Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Signal Generator and an Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.17.1 Lower Panel Control Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.17.2 for fault isolation.

1. Deenergize the receiver.

2. Remove the front panel and gently pull it out several inches from the receiver main chassis, being careful not to place any strain on the interconnecting cables.

3. Connect the Oscilloscope Vertical input to connector A10A2J3 using a short coaxial cable with clip leads on one end. Connect cable shield to terminal A10A2E1.

4. Connect the Signal Generator AM Output to terminal A10A2E9 using a short coaxial cable with clip leads on one end. Connect cable shield to terminal A10A2E1. Set the Signal Generator Modulation Frequency to 400 Hz, set Audio Output Level to 70 mV and set AM switch to INT.

5. Energize the receiver and rotate the Phone Level control fully clockwise. The Oscilloscope should display a level of ~ 20 V p-p. The waveform should be a clean sine wave.

6. Move the Signal Generator output lead to terminal A10A2E2 and move the Oscilloscope input lead to connector A10A2-J2. The Oscilloscope should display a level of ~20 V p-p. The waveform should be a clean sine wave.

7. Deenergize the receiver and disconnect test equipment

4.7.17.2 Lower Panel Control Fault Isolation

The following list of Supplementary Troubleshooting Data is used as an aid in fault isolation. Use the Troubleshooting Data to isolate the fault to a stage or a circuit and then to trace the fault to a defective component or connection. After the fault has been corrected, check the Lower Panel Control for normal operation by repeating the procedure in paragraph 4.7.17.1 above.

1.	Figure 6-21.	WJ-8718 Main Chassis Schematic Diagram
2.	Paragraph 3.4.10.	Lower Panel Control Circuit Description
3.	Figure 5-39.	Lower Panel Control Location of Components
4.	Paragraph 4.7.23.	Parts Replacement Guidelines

4.7.18 1st LO SYNTHESIZER TESTING AND TROUBLESHOOTING

1st LO Synthesizer Testing and Troubleshooting includes a checkout procedure and fault isolation. A Frequency Counter, wideband Oscilloscope and RF Voltmeter (Table 4-2) are required to perform the tests outlined below.

4.7.18.1 1st LO Synthesizer Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.18.2 for Fault Isolation.

1. Deenergize the receiver.

2. Disconnect connector from A1J2.

3. Connect the Frequency Counter to W2P3.

4. Energize the receiver and tune it to 00.00000 MHz. The Frequency Counter should indicate 171.64 MHz.

5. Rotate the tuning knob counterclockwise and tune receiver to 29.99999 MHz. The Frequency Counter should indicate 291.60 MHz.

6. Disconnect the Frequency Counter and connect the RF Voltmeter and 50 Ω Probe to W2P3. The Voltmeter should indicate +20 dBm ±2dBm.

7. Deenergize the receiver and disconnect test equpment. Reconnect W2P3.

4.7.18.2 1st LO Synthesizer Fault Isolation

1st LO Synthesizer Fault Isolation includes Troubleshooting Tests to aid in isolating a fault to a defective stage or circuit. Supplementary Troubleshooting Data is provided in paragraph 4.7.18.3 to aid in tracing the fault to a defective component or connection.

1. VCO Band Select Circuitry - Table 4-16 below checks for proper operation of U13, diodes CR8 through CR10, and Q1 through Q3, while dialing different frequencies on the front panel.

Table 4-16. VCO Band Select Code

TUNED FREQUENCY	BAND SELECT OUTPUT (Vdc)		
	E3	E2	E1
0.00 - 3.99 MHz	+ 15	+ 15	+ 15
4.00 - 7.99 MHz	+ 15	+ 15	- 12
8.00 - 11.99 MHz	+ 15	- 12	+ 15
12.00 - 15.99 MHz	+ 15	- 12	- 12
16.00 - 19.99 MHz	- 12	+ 15	+ 15
20.00 - 23.99 MHz	- 12	+ 15	- 12
24.00 - 27.99 MHz	- 12	- 12	+ 15
28.00 - 29.99 MHz	- 12	- 12	- 12

2. Divider Section - With a tuned frequency of 00.00000 MHz, or an input of J1 of 1st and 3rd LO of 171.64 MHz, the following frequencies in Table 4-17 should be found at the corresponding IC pins using a Digital Counter.

Table 4-17. 1st LO Frequency Chart

IC	PIN	FREQ (Hz)	IC	PIN	FREQ (Hz)
U1	7	17 MHz	U9	7	1.68 MHz
U1	9	3.4 MHz	U9	9	80 kHz
U1	10	40 kHz	U9	15	40 kHz
U2	12	3.4 MHz	U10	7	840 kHz
U3	7	40 kHz	U10	7	200 kHz
U3	9	40 kHz	U11	6	40 kHz
U6	3	40 kHz	U11	7	40 kHz
U8	7	340 kHz	U12	5	40 kHz
U9	1	40 kHz	U12	9	40 kHz

3. Phase Detector U5 - Check for 40 kHz signal at input pin 3 of U5. If signal is not present, troubleshoot Time Base Circuits. Check for 40 kHz signal at pin 1 of U5. If not present, troubleshoot 1st LO counter circuits. Refer to Figure 4-18 to understand the function of the phase detector.

4. 1st LO VCO - The 1st LO VCO is located on the 1st and 3rd LO PC board. It is recommended to read the circuit description of the VCO before troubleshooting (paragraph 3.3.8). The frequency of the oscillator, Q1, is controlled by the band select code and the tuning voltage. The correct VCO output frequency can be found by adding 42.91 MHz to the tuned frequency in Table 4-17 and multiplying the result by 4.

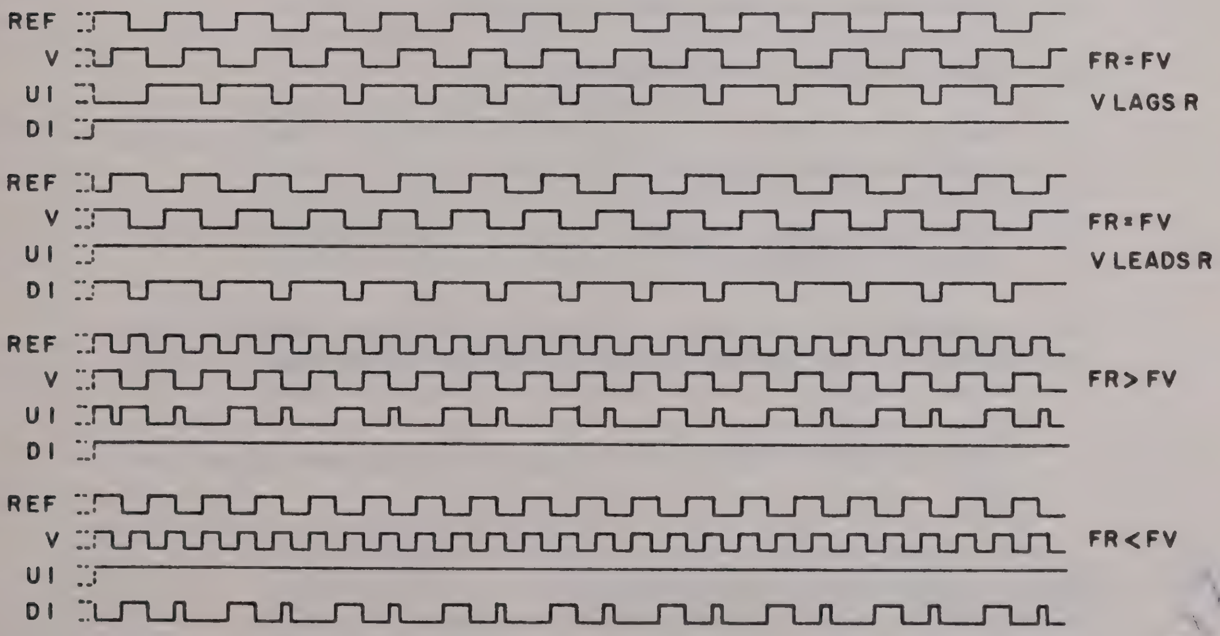


Figure 4-18. Phase Detector Timing Diagram

4.7.18.3 1st LO Synthesizer Supplementary Troubleshooting Data

The following Supplementary Troubleshooting Data is used in conjunction with the Troubleshooting Tests above as an aid in correcting 1st LO Synthesizer faults.

1. Figure 6-13. 1st LO Synthesizer Schematic Diagram
2. Paragraph 3.3.9. 1st LO Synthesizer Circuit Description
3. Figure 5-26. 1st LO Synthesizer Location of Components
4. Paragraph 4.7.23. Parts Replacement Guidelines
5. Paragraph 4.8.2.1. 1st LO Synthesizer Alignment

4.7.19 2nd LO SYNTHESIZER TESTING AND TROUBLESHOOTING

2nd LO Synthesizer Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Frequency Counter, wideband Oscillocope, and RF Voltmeter (Table 4-2) are required to perform the tests outlined below.

4.7.19.1 2nd LO Synthesizer Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.19.2 for fault isolation.

1. Deenergize the receiver.
2. Disconnect connector W4P4 from A2J1.
3. Connect the Frequency Counter to P4.
4. Energize the receiver and tune to 00.00000 MHz. The Frequency Counter should indicate 32.21 MHz.
5. Tune the receiver to 00.00999 MHz. The Frequency Counter should indicate 32.20 MHz.
6. Disconnect the Frequency Counter and connect the RF Voltmeter and 50 Ω probe to W4P4. The Voltmeter should indicate 0 dBm ± 2 dBm.
7. Deenergize the receiver and disconnect test equipment. Reconnect P4.

4.17.19.2 2nd LO Synthesizer Fault Isolation

2nd LO Synthesizer Fault Isolation includes Troubleshooting Tests to aid in isolating a fault to a defective stage or circuit. Supplementary Troubleshooting Data is provided in paragraph 4.7.19.3 to aid in tracing the fault to a defective component or connection.

1. Determine which of the phase lock loops is causing the problem. When the problem loop is determined, troubleshoot as described below.

    a. 32 MHz Loop - Proper operation of this loop assures a 32 MHz signal to be found on the transistor case (or collector) of Q1. If not, proceed to Step b below.

    b. Programmable Loop - Proper operation of this loop assures a 200 kHz signal at pin 1 of U6 when the receiver is tuned to 15.00999 MHz and a 210 kHz signal at pin 1 of U6 when the receiver is tuned to 15.00000 MHz. Illumination of LED CR1 assures a faulty loop. If a problem is not detected, proceed to step c below.

    c. Output Loop - Troubleshooting this loop is required when no problems exist in the two loops tested above and 32.30 to 32.21 MHz is not seen at module pin B15. If so, proceed to Step 3.

2. 32 MHz Loop

    a. U3 and U2 - U3 is a divide-by-2 counter. The time for two input waveforms at pin 3 of U3 equals the time for one output waveform at pin 5 of U3. If not, determine that the input levels are correct for TTL (low state less than 0.8 V, high state greater than 2.0 V). If these levels do exist and the output is not correct, replace U3. U2 is a divide-by-16 counter. The time for 16 input waveforms at pin 8 of U2 equals the time for one output waveform at pin 12 of U2. If not, replace U2.

    b. Assure proper operation of phase detector U1. Check 1 MHz reference at pin 1 of U1. If wrong or no signal, troubleshoot Time Base circuits. A working voltage may vary from 2.0 to 3.5 Vdc (at pin 8 of U1).

    c. Vary capacitor C51 (inside shielded unit) until 2.7 Vdc (nominal) is seen at test point E1, when the tuning tool is withdrawn from the shield.

3. Programmable Loop

    a. U19, U17 and U6 - The time for one waveform at pin 5 of U19 equals 10 waveforms at pin 6 of U19. If not, replace U19. The time for one waveform at pin 12 of U17 equals 10 waveforms at pin 8 of U17. If not, replace U17. The time for one waveform at pin 7 of U16 equals 10 waveforms at pin 15 of U16 (difficult to read with scope since frequency at pin 15 varies from 200 - 210 MHz). If not, replace U16.

b. Operation of ÷100/÷101 prescaler - Tune the receiver to 15.00999 MHz. The time for 10 input waveforms at pin 2 of U14 equals one output waveform at pin 11 of U14. If not, replace U14.

c. Operation of Counters - Tune the receiver to 15.00000 MHz. This sets all inputs (A, B, C, and D) to U7, U8 and U9 with 0 Vdc. Using a frequency counter with an input impedance of greater than 1000 Ω, the following frequencies in Table 4-18 should be found at the corresponding pins. If not, replace that IC.

d. Phase Detector U12 - Check for 10 kHz signal at Pin 1 of U12. If incorrect or no signal, troubleshoot Time Base Circuits. Compare inputs (pins 1 and 3) and outputs 2 and 13 to Figure 4-20 of the lst LO Troubleshooting Test.

e. Tune the receiver to 15.00499 MHz. Spread or compress the turns of coil L8 until 4.0 Vdc is seen at test point E3. Recheck the voltage at test point E3 to be certain that it remains between +2.0 Vdc and 6.5 Vdc as the receiver is tuned from 15.00000 to 15.00999 MHz.

f. If the problem appears to be in the VCO, read Section III, paragraph 3.3.8, then troubleshoot.

4. Output Loop

a. Measure the frequency of the output at module pin B15. If no signal is present, there is a problem in the VCO or its output amplifier. Check gate 1 of Q3 (pin 3) for signal. If there is none, the problem is with the VCO circuit of Q6. If the signal is there, the problem is in the circuit of amplifier Q3. If the signal is present at pin B15, adjust C61 to bring it as close as practical to 32.300 MHz.

b. With the VCO very near 32.200 MHz, check the signals at pins 1 and 3 of U6. Both should be TTL level signals of approximately 200 kHz (that is low less than 0.8 V and high greater than 2.0 V). If the wrong signal is at pin 1, troubleshoot the programmable loop Step 3; if the wrong signal is at pin 3, proceed below.

c. Check the base of Q2. The signal there should be roughly sinusoidal and about 0.5 V p-p. If so, the problem is in the circuits of U14 and U5.

Table 4-18. 2nd LO Frequency Chart

IC PIN	FREQUENCY	IC PIN	FREQUENCY
U7 Pin 14	2.09 MHz	U9 Pin 3	1.05 MHz
U7 Pin 13	100 kHz	U9 Pin 13	130 kHz
U8 Pin 4	100 kHz	U10 Pin 14	130 kHz
U8 Pin 13	10 kHz	U10 Pin 12	10 kHz
U9 Pin 14	2.09 MHz	U10 Pin 11	10 kHz

d. Because of the low signal levels at the inputs of U4 and U5, signal tracing is difficult. The signal at U4 pin 1 should be 32.2 MHz, at U4 pin 7 should be 32.0 MHz, and at U5 pins 1 and 2 should be 200 kHz. Grounding of the scope probe is critical if the true signal is to be isolated. It is more likely that careful visual inspection of these circuits and a few voltage checks will be useful. The voltage at pins 1 and 2 of U15 will be approximately +5 V and must be equal within 0.2 Vdc. If they differ by more than this, replace U4. If the 200 kHz at pins 1 and 2 of U5 can be measured, the output at pin 6 should be amplified by about 10 times from that level. There may be some distortion present at the output of U5 which is reduced at the base of Q2.

e. If the signals at Pins 1 and 3 of U6 both appear correct, compare its outputs at Pins 2 and 13 with those of Figure 4-19. If these appear correct the problem must be in the amplifier section of U6 pins 8 and 9 and its connection to the VCO.

4.7.19.3 2nd LO Synthesizer Supplementary Troubleshooting Data

The following Supplementary Troubleshooting Data is used in conjunction with the Troubleshooting Tests above as an aid in correcting 2nd LO Synthesizer faults:

1.	Figure 6-17.	2nd LO Synthesizer Schematic Diagram
2.	Paragraph 3.3.6.	2nd LO Synthesizer Circuit Description
3.	Figure 5-27.	2nd LO Synthesizer Location of Components
4.	Paragraph 4.7.23.	Parts Replacement Guidelines
5.	Paragraph 4.8.2.2.	2nd LO Synthesizer Alignment

4.7.20 3rd LO SYNTHESIZER TESTING AND TROUBLESHOOTING

3rd LO Synthesizer Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Frequency Counter, wideband Oscilloscope, and RF Voltmeter (Table 4-2) are required to perform the tests outlined below.

4.7.20.1 3rd LO Synthesizer Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.20.2 for fault isolation.

1. Deenergize the receiver.
2. Disconnect connector W6P10 from J7.
3. Connect the Frequency Counter to W6P10.
4. Energize the receiver. The Frequency Counter should indicate 11.155 MHz.
5. Disconnect the Frequency Counter and connect the RF Voltmeter and 50 Ω probe to W6P10. The Voltmeter should indicate -6 dBm ±2 dBm.
6. Deenergize the receiver and disconnect test equipment. Reconnect W6P10.

4.7.20.2 3rd LO Synthesizer Fault Isolation

3rd LO Synthesizer Fault Isolation includes Troubleshooting Tests to aid in isolating a fault to a defective stage or circuit. Supplementary Troubleshooting Data is provided in paragraph 4.7.20.3 to aid in tracing the fault to a defective component or connection.

1. Assure all inputs to the 3rd LO circuitry are correct. If not, troubleshoot Time Base circuits.
    a. 50 kHz signal at pin 11 of U21.
    b. 10 kHz signal at pin of U21.
2. Operation of U21 - The time for two input waveforms at Pin 3 of U21 equals one output waveform at pin 5 of U21. If not, replace U21.
3. Operation of U22 - Observe inputs (pins 1 and 3) and output voltage (pins 2 and 13) and compare to Figure 4-18. If a difference exists, replace U22. A normal value for the output (pin 8) is 2.0 to 3.0 Vdc.

[illegible]

4. Proper alignment of C33 assures an approximate 2.75 Vdc at pin 8 of U22.
5. If problems lead to the VCO, read paragraph 3.3.8 in the Circuit Description Section and troubleshoot.

4.7.20.3 3rd LO Synthesizer Supplementary Troubleshooting Data

The following Supplementary Troubleshooting Data is used in conjunction with the Troubleshooting Tests above as an aid in correcting 3rd LO Synthesizer faults.

See 1 Hz option booklet for further info on 3rd L.O.

1.	Figures 6-15, 6-16.	3rd LO Synthesizer Schematic Diagram
2.	Paragraph 3.3.4.	3rd LO Synthesizer Circuit Description
3.	Figure 5-26.	3rd LO Synthesizer Location of Components
4.	Paragraph 4.7.23.	Parts Replacement Guidelines
5.	Paragraph 4.8.2.4.	3rd LO Synthesizer Alignment

4.7.21 BFO SYNTHESIZER TESTING AND TROUBLESHOOTING

BFO Synthesizer Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Frequency Counter and wideband Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.21.1 BFO Synthesizer Checkout Procedure

Perform the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.21.2 for Fault Isolation.

1. Deenergize the receiver.
2. Disconnect connector W7P11 from J8.
3. Connect the Frequency Counter to W7P11.
4. Energize the receiver and select CW Mode. Set the BFO offset to +0.0 kHz. The Frequency Counter should read 455.000 kHz.
5. Set the BFO Offset first to +8.9 kHz and then to -8.9 kHz. The Frequency Counter should read 463.900 kHz and 446.1 kHz respectively.
6. Disconnect the Frequency Counter and reconnect W7P11 to J8.
7. Connect the Oscilloscope input to A4TP15 using a shielded cable with clip leads on one end. Connect cable shield to the IF Motherboard ground plane. The Oscilloscope should display a level of ~120 mV p-p at ~446.1 kHz.
8. Deenergize the receiver and disconnect test equipment.

4.7.21.2 BFO Synthesizer Fault Isolation

BFO Synthesizer Fault Isolation includes Troubleshooting Tests to aid in isolating a fault to a defective stage or circuit. Supplementary Troubleshooting Data is provided in paragraph 4.7.21.3 to aid in tracing the fault to a defective component or connection.

1. Set front panel BFO thumbwheel switches to "+0.0".
2. Programmable Circuits - Use this procedure when a 1 kHz signal is not seen entering the phase detector, pin 3 of U9.

a. The frequencies in Table 4-19 should be found at the corresponding IC pins. If a problem is detected, troubleshoot and/or replace the IC from which the signal originates.

Table 4-19. BFO Frequency Chart

IC	PIN	FREQ	IC	PIN	FREQ	IC	PIN	FREQ
U1	2	910 kHz	U2	2	91 kHz	U3	2	9 kHz
U1	3	2.275	U2	3	228 kHz	U3	3	23 kHz
U1	4	0	U2	4	455 kHz	U3	4	46 kHz
U1	6	455 kHz	U2	6	46 kHz	U3	6	5 kHz
U1	7	455 kHz	U2	7	46 kHz	U3	7	5 kHz
U1	11	1 kHz	U2	11	1 kHz	U3	11	1 kHz
U1	14	4.55 MHz	U2	14	4.55 MHz	U3	14	4.55 MHz
U4	2	1 kHz	U5	2	1 kHz	U6	10	27 kHz
U4	3	3 kHz	U5	4	1 kHz	U6	11	24 kHz
U4	4	5 kHz	U5	5	5 kHz	U6	12	12 kHz
U4	6	1 kHz	U5	6	5 kHz	U6	13	13 kHz
U4	7	1 kHz	U6	1	5 kHz	U7	1	455 kHz
U4	11	1 kHz	U6	2	46 kHz	U7	2	455 kHz
U4	14	4.55 MHz	U6	3	12 kHz	U7	4	910 kHz
U5	8	27 kHz	U6	4	228 kHz	U7	5	2.275 kHz
U5	9	9 kHz	U6	5	455 kHz	U7	6	455 kHz
U5	10	23 kHz	U6	6	24 kHz	U7	8	4.55 kHz
U5	12	46 kHz	U6	8	1 kHz	U7	9	4.55 kHz
U5	13	91 kHz	U6	9	1 kHz	U8	2	1 kHz

3. Phase Detector U9

a. 1 kHz signal should be seen at pin 1 of U9. If not, troubleshoot Time Base circuits.

b. A voltage level of roughly 1.25 Vdc should be seen at pin 10 of U9. If not, replace U9.

c. Adjust capacitor C8 until a 2.7 Vdc level is seen at module pin 7.

4. Amplifier Q2 and Sine Wave to TTL Converter Q3 should be troubleshot when the signal from the VCO through capacitor C10 is not amplified at the collector of Q3. Refer to the circuit description for these circuits, Section 3.

5. Output Divider U10 - Use Table 4-20 below to check the operation of U10 with the BFO thumbwheel settings set to "+0.0".

Table 4-20. Output Divider U10 Frequency Chart

IC	PIN	FREQ
U10	1	4.55 MHz
U10	11	910 kHz
U10	12	455 kHz
U10	14	910 kHz

4.7.21.3 BFO Synthesizer Supplementary Troubleshooting Data

The following Supplementary Troubleshooting Data is used in conjunction with the Troubleshooting Test above as an aid in correcting BFO Synthesizer Faults.

1.	Figure 6-18.	BFO Synthesizer Schematic Diagram
2.	Paragraph 3.3.5.	BFO Synthesizer Circuit Description
3.	Figure 5-28.	BFO Synthesizer Location of Components
4.	Paragraph 4.7.23.	Parts Replacement Guidelines
5.	Paragraph 4.8.2.6.	BFO Synthesizer Alignment

4.7.22 TIME BASE TESTING AND TROUBLESHOOTING

Time Base Testing and Troubleshooting includes a checkout procedure and fault isolation information. A Frequency Counter and a wideband Oscilloscope (Table 4-2) are required to perform the tests outlined below.

4.7.22.1 Time Base Checkout Procedure

Perfom the following procedure in the sequence given. If any specified result is not obtained, refer to paragraph 4.7.22.2 for Fault Isolation.

1. Deenergize the receiver.
2. Connect the Frequency Counter input to A5XA1 pin A9 using a short coaxial cable with clip leads on one end. Connect cable shield to Motherboard ground plane.
3. Energize the receiver. The Frequency Counter should read 1.000000 MHz ±3 Hz.
4. Move the Frequency Counter clip lead to A5XA1 pin A47. The Frequency Counter should read 10.000 kHz ±1 Hz.
5. Move the Frequency Counter clip lead to A5XA1 pin A53. The Frequency Counter should read 1.000 kHz ±1 Hz.

6. Move the Frequency Counter clip lead to test point A5A1A2 pin E6. The Frequency counter should read 40.000 kHz ±1 Hz.

7. Deenergize the receiver and disconnect test equipment.

4.7.22.2 Time Base Fault Isolation

Time Base Fault Isolation includes Troubleshooting Tests to aid in isolating a fault to a defective stage or circuit. Supplementary Troubleshooting Data is provided in paragraph 4.7.22.3 to aid in tracing the fault to a defective component or connection.

Using the internal frequency source, the frequencies in Table 4-21 should be found at the corresponding IC pins. A Digital Counter is the recommended method to check the frequencies, however, an Oscilloscope may be used remembering the time for one input waveform is proportional to the time for one output waveform by the dividing ratio of the IC.

Table 4-21. Time Base Frequency Chart

IC	PIN	FREQUENCY	IC	PIN	FREQUENCY
U15	5	1 MHz	U18	12	10 kHz
U15	6	1 MHz	U19	5	250 kHz
U15	8	2 MHz	U19	12	50 kHz
U15	12	200 kHz	U20	5	5 kHz
U17	12	40 kHz	U20	12	1 kHz
U18	5	500 kHz	U23	8	1 MHz
U18	8	1 MHz	U23	11	1 MHz

4.7.22.3 Time Base Supplementary Troubleshooting Data

The following list of Supplementary Troubleshooting Data is used as an aid in correcting Time Base faults.

1. Figures 6-15, 6-16. 1st and 3rd LO Synthesizer/Time Base Schematic Diagram
2. Paragraph 3.3.3. Time Base Circuits Description
3. Figure 5-26. 1st and 3rd LO Synthesizer/Time Base Location of Components
4. Paragraph 4.7.23. Parts Replacement Guidelines
5. Paragraph 4.8.2.5. 2 MHz Time Base Alignment

4.7.23 PARTS REPLACEMENT GUIDELINES

This paragraph provides techniques to assist the Technician in replacing components on PC boards.

WARNING

To prevent electrical shock or damage to the receiver, always disconnect the receiver from the ac power source before soldering or replacing components.

4.7.23.1 Soldering Techniques

When removing components from a printed circuit board for inspection or replacement, be especially careful not to damage the track. The soldering iron power should be no larger than 40 W, and a solder sipper or wicking procedure should be employed when removing solder. Non-corrosive soldering flux should be used when removing solder by wicking. In returning components to the board, make sure that holes are clear and that leads do not catch the edge of the track and lift it from the board. A good grade of rosin core 60/40 solder should be used. Heat no longer than is necessary to achieve a good joint. A heat sink should be used where possible.

4.7.23.2 Component Replacement

Specific guidelines for replacing the various kinds of components are as follows.

1. When soldering or unsoldering diodes or resistors, solder quickly to allow as little heat conduction as possible. When wiring permits, use a heat sink between the soldering iron and the part.

2. When soldering or unsoldering transistors, use a low wattage iron and a heat sink. Solder as quickly as possible. The use of a circular soldering tip to heat all three or four joints simultaneously is recommended.

3. When soldering or unsoldering glass or ceramic capacitors, use a heat sink between the capacitors and the iron. Excessive heat will crack the capacitor body.

4. When any electronic part is removed, note the position of the part and its leads, and replace it the same way.

4.7.23.3 Realignment

Replacement of semiconductors or tuned circuit components may affect the alignment of the PC board being repaired. Realignment may be necessary to return the PC board to normal operation.

4.8 ADJUSTMENT/ALIGNMENT PROCEDURES

4.8.1 GENERAL

The following Adjustment and Alignment Procedures should not be performed on a routine basis, but instead, should be used as aids in troubleshooting and post-repair testing. Before alignment is attempted, the technician should first perform the relevant procedures to determine which module needs alignment. These procedures may be used for testing or aligning new and repaired modules.

4.8.2 SYNTHESIZER ALIGNMENT

4.8.2.1 1st LO Synthesizer Alignment

The only alignment points for the 1st LO Synthesizer are in the 1st LO VCO (A5A1A1) which is a very sensitive circuit; care must be taken to ensure proper operation. This procedure should be performed only when a definite alignment is needed. Table 4-22 lists the components and their parameters used in this alignment procedure.

1. Mount the 1st and 3rd LO on an extender card.
2. Remove the VCO front plate.
3. Connect a Digital Voltmeter to module pin B1.
4. Align the VCO from band 0 to band 7. As suggested in Table 4-22, components L2, L3, and L4 align the VCO in more than one band.
5. Align each VCO band monitoring the voltage at module pin B1. Then check the 1st LO frequency band (test point E3 in the VCO) while dialing the tuned frequency in 10 kHz steps starting with 00.00000 MHz.

Table 4-22. VCO Alignment Parameters

VCO Band	1st LO FREQ BAND (MHz)	VOLTAGE Pin B1 (Typical)	ALIGNMENT COMPONENT
0	42.91-46.90	-8.5 to 6.0	C6*, L1
1	46.91-50.90	-7.5 to 4.1	L2
2	50.91-54.90	-7.2 to 2.8	L3
3	54.91-54.90	-5.3 to 3.9	L2, L3
4	58.91-62.90	-6.6 to 2.7	L4
5	62.91-66.90	-6.0 to 2.2	L4, L2
6	66.91-70.90	-6.2 to 0.4	L3, L4
7	70.91-72.90	-5.7 to -3.0	L4, L3, L2

* Factory Select Value

4.8.2.2 2nd LO Synthesizer Alignment (A5A2)

The 2nd LO Synthesizer procedure consists of a 32 MHz Loop Alignment, a Programmable Loop Alignment, and an Output Loop Alignment. Perform the procedure in the given sequence.

CAUTION

For optimum results, the 2nd LO Synthesizer Alignment should be performed in an ambient temperature of +25° C ±5° C.

1. Preliminary Setup

   a. Remove the top protective cover from the receiver.

   b. Mount the 2nd LO Synthesizer board (A5A2) on an extender card.

   c. Energize the receiver and allow 30 minutes warm-up time.

   d. Using a Digital Voltmeter, verify that +15 Vdc ±0.25 Vdc is present at pins B5, B41, and A59, and that +5 Vdc ±0.25 Vdc is present at pins A1, B1, and B45.

   e. Using a Frequency Counter, verify that the 1 MHz reference frequency at pin B49 is 1.000000 MHz and that the 10 kHz reference frequency at pin A57 is 10.000 kHz.

NOTE

If the two reference frequencies are not correct, perform the Time Base Adjustment Procedure before proceeding with the 2nd LO Synthesizer Alignment.

2. 32 MHz Loop Alignment

   a. Connect the Digital Voltmeter to test point E1.

   b. Adjust capacitor C51 until a Voltmeter reading of +3.0 Vdc is observed with the alignment tool withdrawn from the VCO shield.

3. Programmable Loop Alignment

   a. Connect the Digital Voltmeter to test point E3.

   b. Tune the receiver to 00.00499 MHz.

   c. Insert an alignment tool in the VCO shield opening and spread or squeeze the turns of L8 until a Voltmeter reading of +4.0 Vdc is observed with the alignment tool withdrawn from the VCO shield.

32.20501
32.20499

4. Output Loop Alignment

   a. Connect the Digital Voltmeter to test point E2.

   b. Tune receiver to 00.00499 MHz.

   c. Adjust capacitor C61 until a Voltmeter reading of +3.0 Vdc is observed with the alignment tool withdrawn from the VCO shield.

   d. Using the Frequency Counter, verify that a frequency of 32.205010 MHz ±3 Hz is present at output pin B15.

5. Final Adjustments

   a. Deenergize the receiver.

   b. Remove the 2nd LO Synthesizer board from the extender card and return it to the receiver.

   c. Mount the top protective cover on the receiver (use only four fasteners to secure the top cover).

   d. Energize the receiver and allow it to operate for a minimum of 30 minutes.

   e. Tune the receiver to 00.00499 MHz.

   f. With the receiver in operation, remove the bottom protective cover.

   g. Using the Digital Voltmeter, check the Loop Test Point Voltages as indicated in Table 4-23.

Table 4-23. Loop Test Point Voltages

Parameter	Pin Number	Test Point Voltage
32 MHz Loop TP	A5XA2-B57	+3 Vdc ±0.1 Vdc
Programmable Loop TP	A5XA2-A51	+4 Vdc ±0.1 Vdc
Output Loop TP	A5XA2-A55	+3 Vdc ±0.1 Vdc

NOTE

Test Point Voltages may drift from initial settings. If any Test Point Voltage is not within tolerance, repeat the appropriate loop alignment procedure. Set the Test Point Voltage(s) high or low as required to compensate for any drift observed in Step g. Do not proceed to Step h until the voltages in Table 4-23 are observed after the receiver has been in operation for 30 minutes with both covers in place.

h. Using the Frequency Counter, verify that a frequency of 32.2005010 MHz ±3 Hz is present at pin A5XA2-B15.

i. Tune the receiver first to 00.00000 MHz and then to 00.00999 MHz. The appropriate Loop Test Point Voltages and the 2nd LO Output Frequency are given in Table 4-24.

Table 4-24. 2nd LO Synthesizer Tuning Parameters

Parameter	Pin Number	Receiver Tuned Frequency 00.00000 MHz	 00.00999 MHz
32 MHz Loop TP	A5XA2-B57	+3 Vdc ±0.2 Vdc	+3 Vdc ±0.2 Vdc
Programmable Loop TP	A5XA2-A51	> 1.5 Vdc	< 7.0 Vdc
Output Loop TP	A5XA2-A55	+3 Vdc ±0.2 Vdc	+3 Vdc ±0.2 Vdc
2nd LO Frequency	A5XA2-B15	32.21000 MHz	32.20010 MHz

j. Mount the top protective cover on the receiver.

k. This completes the 2nd LO Synthesizer Alignment Procedure.

4.8.2.3 2nd LO Filter Adjustment

1. Deenergize the receiver.
2. Disconnect connector P4 from A2J1 of Input Converter (A3).
3. Connect the RF Voltmeter and 50 Ω adapter to P4.
4. Set Voltmeter to 0 dBm (0.3 mV) scale and energize the receiver.
5. Adjust A5C13 for maximum Voltmeter reading. A5C13 is located on the bottom side of the Synthesizer Motherboard (A5) near the front panel of the receiver.

4.8.2.4 3rd LO Synthesizer Alignment

[illegible] 1st Edition

1. Deenergize the receiver.
2. Mount the 1st and 3rd LO Synthesizer (ASA1A2) on extender cards and connect the Digital Voltmeter to Pin 8 of U22.
3. Energize the receiver. Adjust capacitor C33 until a reading of 3.0 Vdc is seen on the Voltmeter.
4. Deenergize the receiver and disconnect Digital Voltmeter.

4.8.2.5 2 MHz Time Base Adjustment

NOTE

> Before performing the following adjustment, the receiver should have been in operation for at least one hour at normal operation temperature to allow the circuit to stabilize.

1. Deenergize the receiver.
2. Mount 1st and 3rd LO Synthesizer (ASA1A2) on extender cards.
3. Connect the Digital Counter to rear panel 1 MHz Ref connector J11.
4. Set the Clock switch S2 to INT position.
5. Energize the receiver. Allow at least a 5 minute warm-up to stabilize the circuits. (This assumes power was not off more than 5 minutes to make the cable connections.)
6. While observing the Counter display, adjust 2 MHz Crystal Oscillator (U14) for a reading of 1.000000 MHz ±3 Hz.
7. Deenergize the receiver and disconnect Digital Counter. Replace A5A1A2 board into the proper slots.

4.8.2.6 BFO Synthesizer Alignment

Two alignments are required for the BFO Synthesizer (A5A3). Capacitor C8 and resistor R1 are interdependent and must be aligned simultaneously.

1. Mount the BFO Synthesizer board on extender cards.
2. Adjust C8 until the closest reading to 3.0 Vdc is seen at module pin 7.
3. Adjust R1 until the voltage difference between gate to source of Q4 (Pins 3 and 2) is 0 Vdc. (The voltage from gate to ground and from source to ground will be approximately 1.2 Vdc.)
4. Adjust C8 again until the closer reading to 3.0 Vdc is seen at module pin 7.

4.8.3 RECEIVER ALIGNMENT

4.8.3.1 Input Converter Alignment

1. Deenergize the receiver and loosen the two (2) captivated screws holding the A3 module to the chassis. Pull the A3 module out and remove its cover. Connect test equipment as shown in

Figure 4-19. Be careful that Input Converter does not short to the adjacent power supply circuitry.

2. Set receiver controls as follows:

    a. Meter - Signal Strength
    b. Gain Mode - Manual
    c. Detection Mode - AM
    d. RF Gain - Maximum Clockwise
    e. Phone Level - N/A
    f. IF Bandwidth - 16 kHz
    g. BFO offset - N/A

3. Energize the receiver.

4. Set the Signal Generator to -97 dBm, unmodulated at 15.0050 MHz. Tune receiver to 15.00500 MHz.

5. While observing RF Voltmeter, adjust C3 of A3A1 and C1 of A3A2 for a maximum meter reading of approximately -15 dBm (40 mV).

6. Deenergize the receiver and disconnect test equipment.

7. Replace the cover on the Input Converter (A3). Install the Input Converter in chassis.

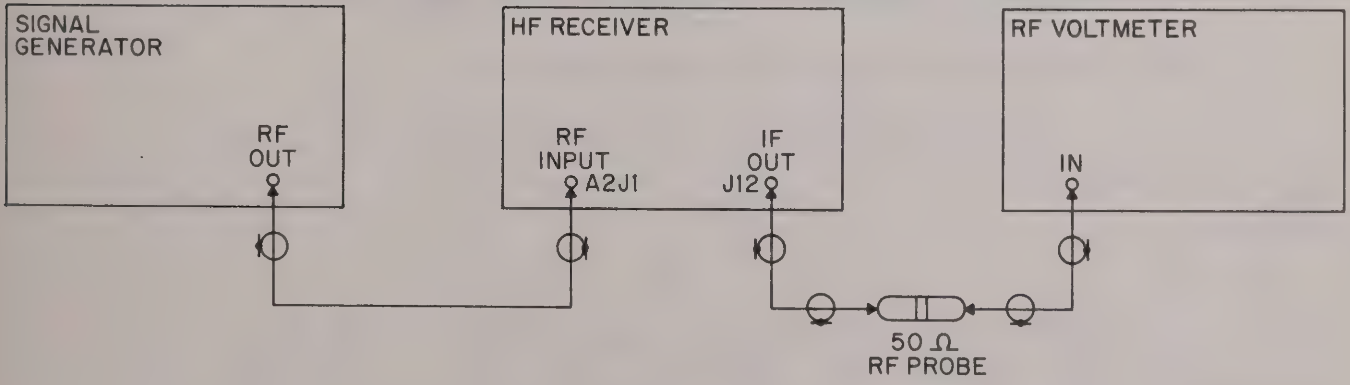


Figure 4-19. Input Converter Alignment,Test Setup

4.8.3.2 10.7 MHz Filter Switch Adjustment

1. Deenergize the receiver.
2. Connect the test equipment as shown in Figure 4-20. Set the Generator for 10.700 MHz, unmodulated, at -50 dBm.
3. Remove A4A1 and A4A2 boards.

NOTE

A4A2 is removed to eliminate loading.

4. Place A4A1 on an extender card.
5. Energize the receiver.
6. Depress the 3.2 kHz IF Bandwidth button and adjust A4A1R7 for a -36 dBm (3.5 mV) RF Voltmeter reading.

NOTE

If -36 dBm cannot be obtained, adjust for maximum dBm reading. Record this reading.

7. Depress the 6 kHz IF Bandwidth button and adjust A4A1R39 for the same dBm reading obtained in step 6.
8. Depress the 16 kHz IF Bandwidth button and adjust A4A1R39 for the same dBm reading obtained in step 6.
9. Deenergize the receiver and disconnect test equipment.
10. Install A4A2 and A4A1 into the proper slots.

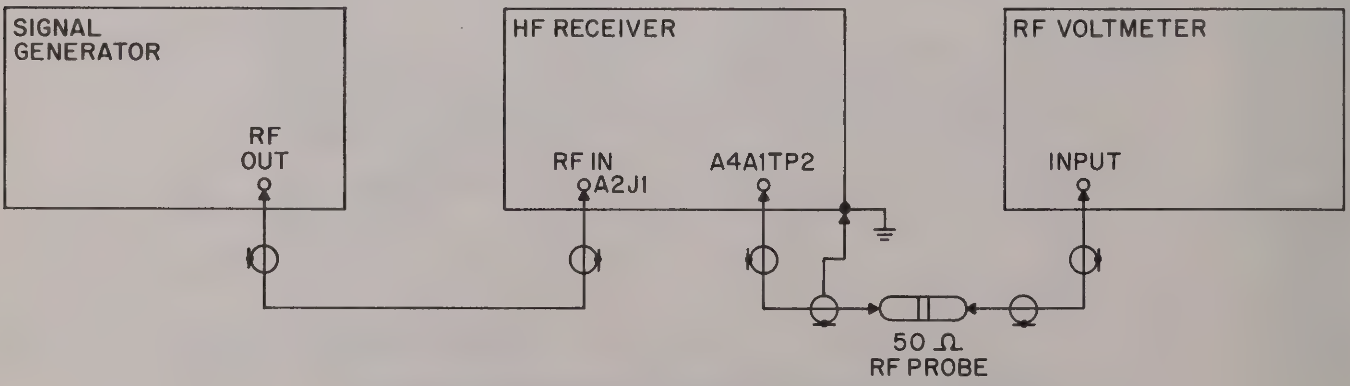


Figure 4-20. 10.7 MHz Filter Switch Adjustment, Test Setup

4.8.3.2a 10.7 MHz Filter Switch Adjustment (REVISION E)

1. Disconnect P28, 10.7 MHz input to IF strip (at jack A2J2 of Input Converter). Feed 10.7 MHz unmodulated signal at -50 dBm level, into P28 or TP1 input of IF motherboard as shown in Figure 4-20a.

2. Remove card A4A2 and set A4A1 on extender card.

3. Connect input of RF Voltmeter, terminated in 50Ω to TP2.

4. Depress the 3.2 kHz Bandwidth button and adjust R26 for a -36 dBm reading.

5. Depress the 6 kHz Bandwidth button and adjust R28 for a -36 dBm reading.

6. Depress the 16 kHz Bandwidth button and adjust R30 for a -36 dBm reading.

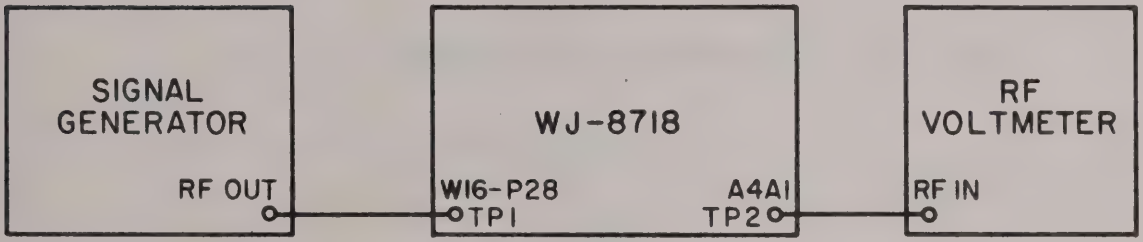


Figure 4-20a. Test Setup, 10.7 MHz Filter Switch Adjustment

THIS PAGE LEFT BLANK

4.8.3.3 455 kHz Amplifier/AM Detector Response Alignment

1. Deenergize the receiver.
2. Remove cards A4A3 and A4A10. Place A4A7 on an extender card.
3. Connect the test equipment as shown in Figure 4-21.
4. Set up the Sweep Generator as follows:

    a. Power - ON
    b. CW/Sweep - SYM
    c. Trig/Line/Free - Line
    d. Fast/Slow/Manual - Fast
    e. Crystal Cal - OFF
    f. Range - 11
    g. Sym Sweep Width Vernier - .1/1
    h. 1 kHz Mod - OFF
    i. Output Level - -60 dBm
    j. Frequency - 455 kHz

5. Set up the Marker Generator for a 455 kHz output, unmodulated, at -80 dBm.
6. Set the receiver controls as follows:

    a. Meter - N/A
    b. Gain Mode - Manual
    c. Detection Mode - N/A
    d. RF Gain - Maximum Clockwise
    e. Phone Level - N/A
    f. IF Bandwidth - N/A
    g. Receiver Frequency - N/A
    h. BFO offset - N/A

7. Energize the receiver. Adjust Sweep Generator Frequency control to center the response pattern on the Oscilloscope screen.
8. Adjust A4A17L2 and A4A7L3 for an Oscilloscope waveform which has maximum amplitude and is symmetrical about the marker. See Figure 4-22 for a typical waveform.
9. Deenergize the receiver and disconnect test equipment.
10. Install A4A3 and A4A10 cards in the proper card slots.

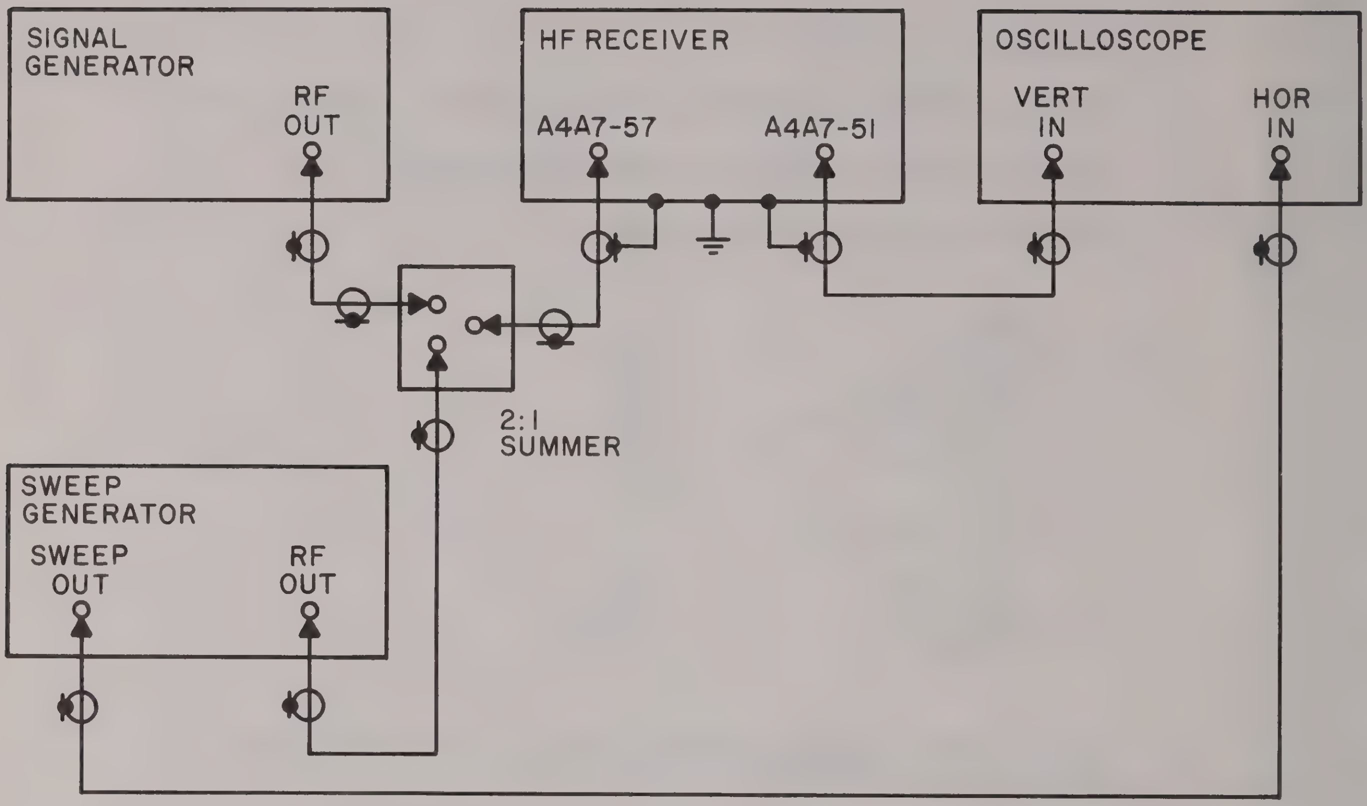


Figure 4-21. 455 kHz Amplifier/AM Detector Response Alignment, Test Setup

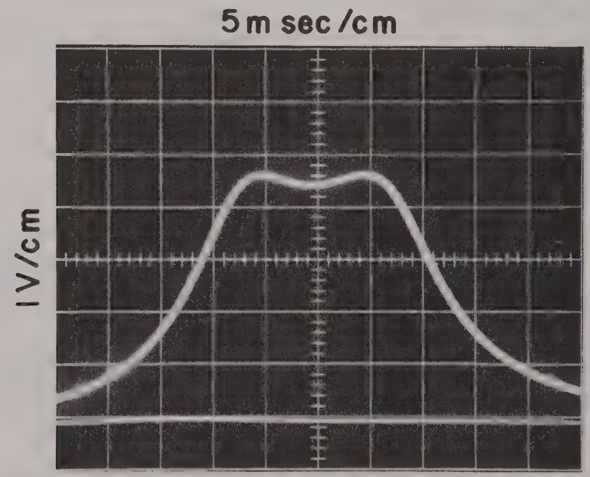


Figure 4-22. 455 kHz Amplifier/AM Detector Response Alignment, Typical Response

4.8.3.4 455 kHz Amplifier/AM Detector Gain Adjustment

1. Connect the test equipment as shown in Figure 4-23.

2. Set the receiver controls as follows:

   a. Meter - Signal Strength
   b. Gain Mode - Manual
   c. Detection Mode - AM
   d. RF Gain - Maximum Clockwise
   e. Phone Level - N/A
   f. IF Bandwidth - 6 kHz
   g. BFO offset - N/A

3. Energize the receiver.

4. Set the RF Voltmeter to the 100 mV scale.

5. Set the Signal Generator to 15.0050 MHz, unmodulated at -97 dBm (3 μV). Also tune receiver to 15.00500 MHz.

6. Adjust A4A7R7 for a 40 mV reading on the RF Voltmeter.

7. Deenergize the receiver and disconnect test equipment.

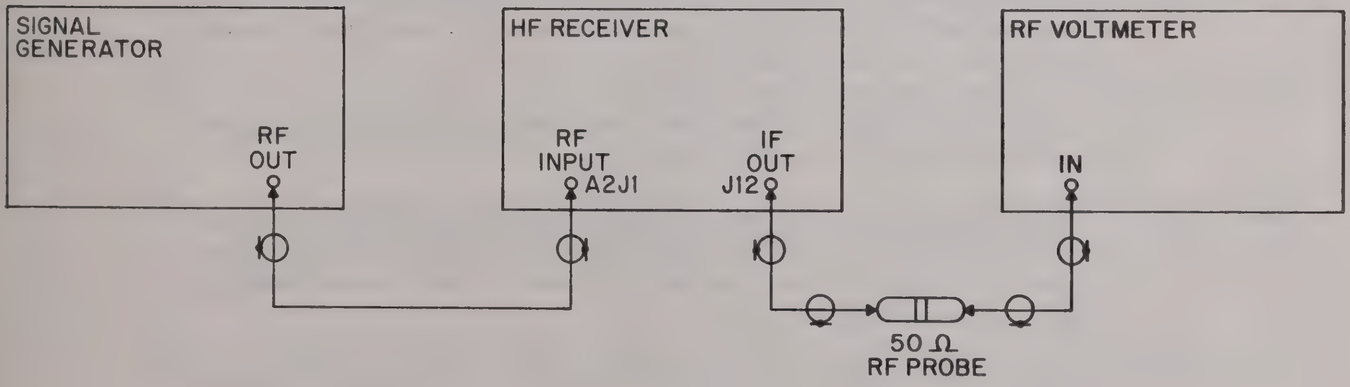


Figure 4-23. 455 kHz Amplifier/AM Detector Gain Adjustment, Test Setup

4.8.3.5 USB Filter Switch and ISB/LSB Filter Switch Adjustment

The purpose of this adjustment is to equalize the output levels of A4A4 and A4A5.

1. Deenergize the receiver.

2. Connect the RF output of the Signal Generator to RF Input connector A2J1.

3. Put A4A5 on an extender card and A4A4 on two extender cards.

4. Set the receiver controls as follows:

a.	Meter	-	Signal Strength
b.	Gain Mode	-	Manual
c.	Detection Mode	-	AM
d.	RF Gain	-	Maximum Clockwise
e.	Phone Level	-	Midway
f.	IF Bandwidth	-	16 kHz
g.	BFO offset	-	N/A

5. Energize the receiver.

6. Tune the receiver to 15.00500 MHz and set the Signal Generator to a 15.0050 MHz unmodulated signal.

7. Adjust the Signal Generator output level until the Signal Strength meter reads the SET level.

8. Change the Signal Generator frequency to 15.0054 MHz and receiver detection mode to USB.

9. Adjust potentiometer A4A4R11 until the meter reads the set level or until R11 is at its maximum setting, whichever occurs first. Record the meter level.

10. Change the Signal Generator frequency to 15.0046 MHz and receiver detection mode to LSB.

11. Adjust potentiometer A4A5R11 until the meter reads the level obtained in step 8. If the step 8 level cannot be obtained, set A4A5R11 at its maximum setting, record the meter reading, and perform steps 11 and 12.

12. Change the Signal Generator frequency to 15.0054 MHz and receiver detection mode to USB.

13. Adjust potentiometer A4AR11 until the meter reads the level obtained in step 10.

14. Deenergize the receiver and disconnect test equipment.

4.8.3.6 ISB Detector/Audio Adjustment

1. Deenergize the receiver and connect the equipment as shown in Figure 4-24.

4.8.3.5a USB Filter Switch (REVISION G) and ISB/LSB Filter Switch (REVISION E) Adjustment.

1. Deenergize receiver.

2. Connect the RF output of the Signal Generator to RF Input connector A2J1.

3. Put A4A5 on an extender card and A4A4 on two extender cards.

4. Set receiver controls as follows:

    a. Meter - Signal Strength
    b. Gain Mode - Manual
    c. Detection Mode - AM
    d. RF Gain - Maximum Clockwise
    e. Phone Level - Midway
    f. IF Bandwidth - 16 kHz
    g. BFO offset - N/A

5. Energize receiver.

6. Tune receiver to 15.00500 MHz and set the Signal Generator to a 15.0050 MHz unmodulated signal.

7. Adjust the Signal Generator output level until the Signal Strength meter reads the SET level.

8. Change the Signal Generator frequency to 15.0054 MHz and receiver detection mode to USB.

9. Adjust potentiometer A4A4R23 until the meter reads the set level or until R11 is at its maximum setting, whichever occurs first. Record the meter level.

10. Change the Signal Generator frequency to 15.0046 MHz and receiver detection mode to LSB.

11. Adjust potentiometer A4A5R23 until the meter reads the level obtained in step 8. If the step 8 level cannot be obtained, set A4A5R23 at its maximum setting, record the meter reading, and perform steps 11 and 12.

12. Change the Signal Generator frequency to 15.0054 MHz and receiver detection mode to USB.

13. Adjust potentiometer A4AR23 until the meter reads the level obtained in step 10.

14. Deenergize receiver and disconnect test equipment.

2. Set the receiver controls as follows:

a.	Meter	-	N/A
b.	Gain Mode	-	Manual
c.	Detection Mode	-	ISB
d.	RF Gain	-	Maximum Clockwise
e.	Phone Level	-	Maximum Clockwise (Initial Setting)
f.	IF Bandwidth	-	N/A

3. Energize the receiver.

4. Set the Signal Generator to a -105 dBm unmodulated signal at 15.0054 MHz. Also tune the receiver to 15.00500 MHz.

5. With equipment connected properly, a 400 Hz audio output of ~ 26 V p-p should be seen on the Oscilloscope.

6. Adjust the Phone Level gain control on the front panel for the maximum Oscilloscope waveform, without clipping or distortion present. Record this reading. This is the Upper Sideband signal.

7. Change the Signal Generator frequency to 15.0046 MHz.

8. Connect the Oscilloscope to the ring on the phone jack. This is the Lower Sideband signal.

9. Adjust A4A8R8 to obtain the same output obtained in step 5 above, or until output is at its maximum.

10. If the same level as in step 5 cannot be obtained, repeat steps 1 through 8, with the exception of lowering the Phone Level gain control slightly each time, so that step 5 (USB) and step 8 (LSB) waveforms are the same.

11. Deenergize the receiver and disconnect test equipment.

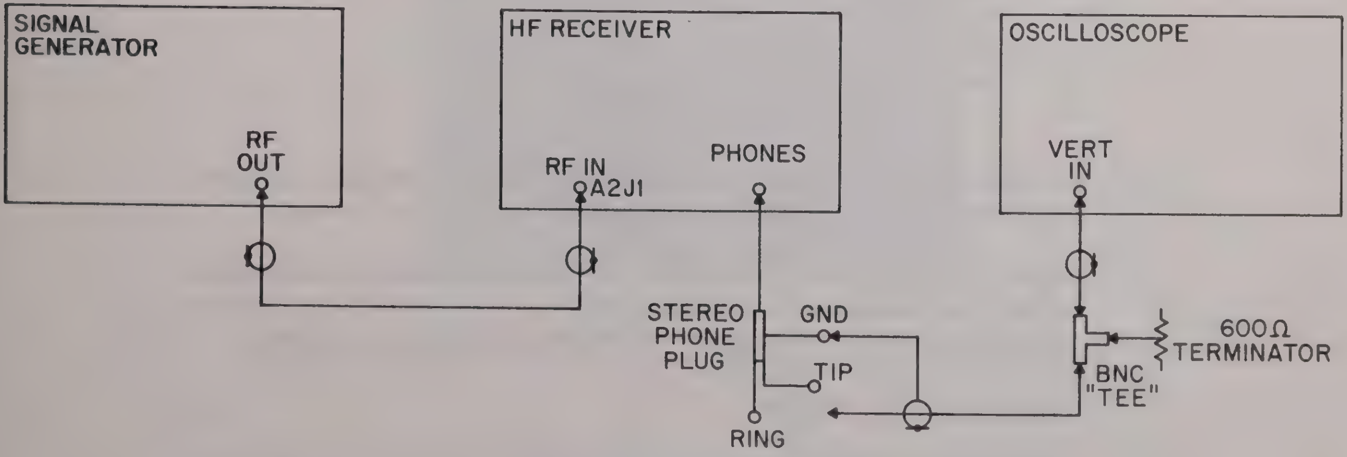


Figure 4-24. ISB Detector/Audio Adjustment, Test Setup

4.8.3.7 FM Discriminator Alignment

1. Deenergize the receiver.
2. Remove cards A4A7, A4A9, and A4A10.
3. Put A4A9 on an extender card.
4. Connect the test equipment as shown in Figure 4-25.
5. Set up the Sweep Generator as follows:
    a. Power - ON
    b. CW/Sweep - SYM
    c. Trig/Line/Free - Line
    d. Fast/Slow/Manual - Fast
    e. Crystal Cal - OFF
    f. Range - 11
    g. Sym Sweep Width Vernier - .1/1
    h. 1 kHz Mod - OFF
    i. Output Level - -10 dBm
    j. Frequency - 455 kHz
6. Set up the Marker Generator for a 455 kHz output, unmodulated, at -25 dBm.
7. Set the receiver controls as follows:
    a. Meter - N/A
    b. Gain Mode - N/A
    c. Detection Mode - FM
    d. RF Gain - N/A
    e. Phone Level - N/A
    f. IF Bandwidth - N/A
    g. Receiver Frequency - N/A
    h. BFO offset - N/A
8. Energize the receiver. Adjust Sweep Generator Frequency control to center the response pattern on the Oscilloscope screen.
9. Adjust A4A9L1 and A4A9T1 for an Oscilloscope waveform which has maximum amplitude and is symmetrical and linear about the marker. See Figure 4-26 for a typical waveform.
10. Deenergize the receiver.
11. Disconnect the test equipment and install A4A7, A4A9, and A4A10 boards into the proper slots.

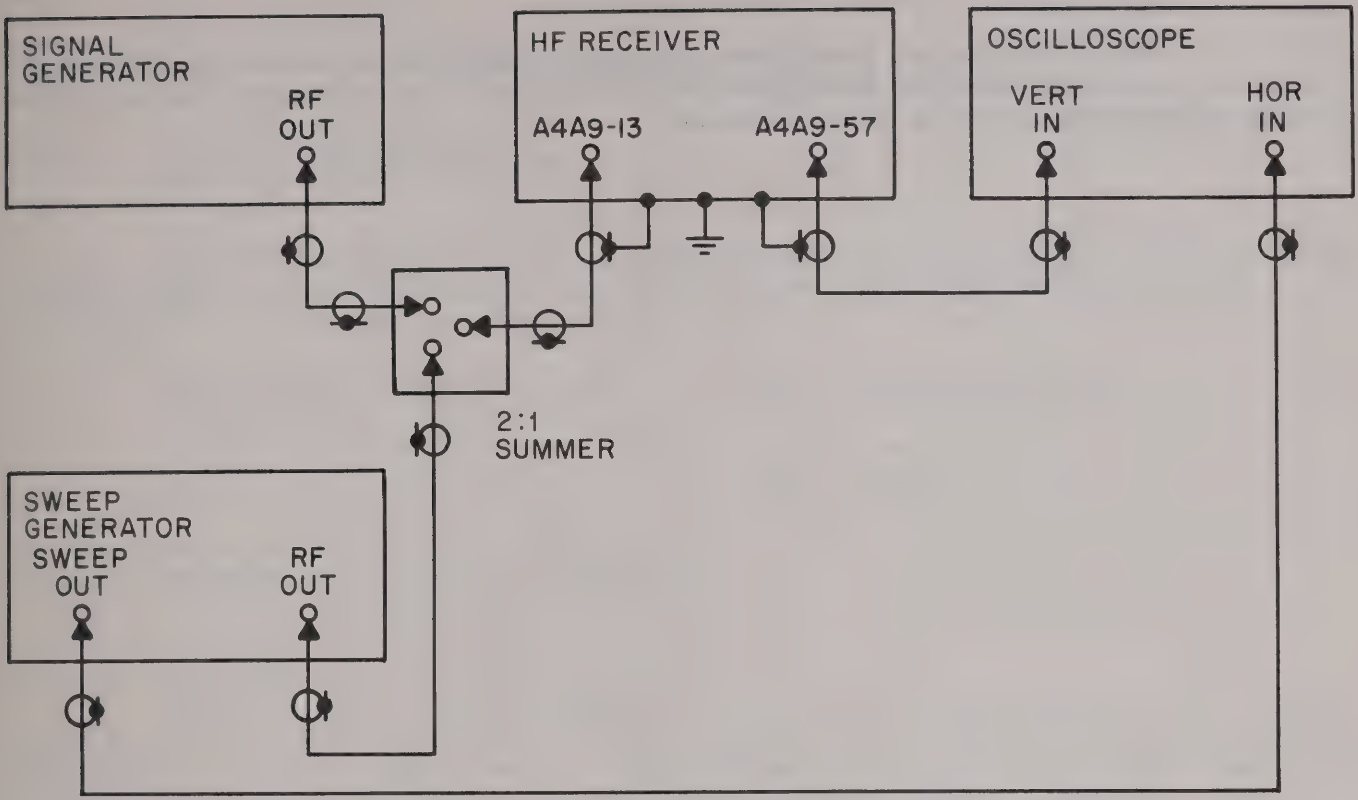


Figure 4-25. FM Discriminator Alignment, Test Setup

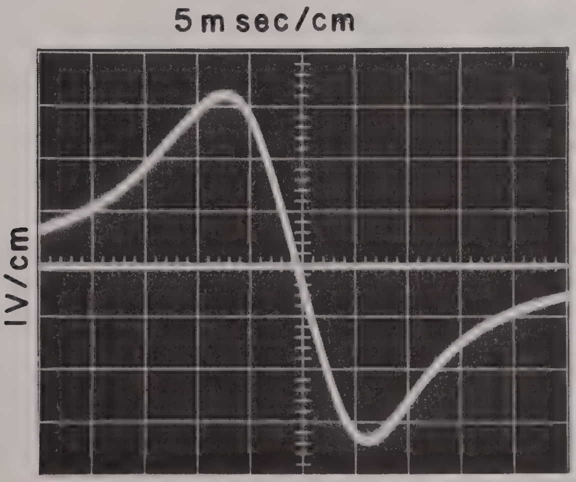


Figure 4-26. FM Discriminator Alignment, Typical Response

4.8.4 LED INTENSITY ADJUSTMENT

The intensity of the front panel Frequency Display can be varied by potentiometer R2, which is located inside the front panel on the left side of the Frequency Display LED's. Turning R2 clockwise increases the LED intensity.

SECTION V

REPLACEMENT PARTS LIST

5.1 UNIT NUMBERING METHOD

The unit numbering method of assigning reference designations (electrical symbol numbers) has been used to identify assemblies, subassemblies (and modules) and parts. An example of the unit numbering method follows:

Subassembly Designation A1	R1 Class and No. of Item
Identify from right to left as:	First (1) resistor (R) of first (1) subassembly (A)

As shown on the main chassis schematic, components which are an integral part of the main chassis have no subassembly designation.

5.2 REFERENCE DESIGNATION PREFIX

Partial reference designations have been used on the equipment and on the illustrations in this manual. The partial reference designations consist of the class letter(s) and identifying item number. The complete reference designations may be obtained by placing the proper prefix before the partial reference designations. Reference Designation Prefixes are provided on drawings and illustrations in parentheses within the figure titles.

5.3 LIST OF MANUFACTURERS

Mfr. Code	Name and Address	Mfr. Code	Name and Address
00779	AMP, Incorporated P.O. Box 3608 Harrisburg, PA 17105	02735	RCA Corporation Solid State Division Route 202 Somerville, NJ 08876
01121	Allen-Bradley Company 1201 South 2nd Street Milwaukee, WI 53204	04013	Taurus Corporation 1 Academy Hill Lambertville, NJ 08530
01295	Texas Instruments, Inc. Semiconductor-Components Div. 15300 North Central Expressway Dallas, TX 75231	04713	Motorola Incorporated Semiconductor Products Div. 5005 East McDowell Road Phoenix, AZ 85008
02114 Inc.	Ferroxcube Corporation P.O. Box 359 Mt. Marion Road Saugerties, NY 12477	06978	Aladdin Electronics Div. of Aladdin Industries, 703 Murfreesboro Road Nashville, TN 37210

Mfr. Code	Name and Address
07263	Fairchild Camera & Instr. Corp. Semiconductor Division 464 Ellis Street Mountain View, CA 94040
07388	Toretel Incorporated 13402 South 71 Highway Grandview, MO 64030
09353	C & K Components, Inc. 103 Morse Street Watertown, MA 02172
12498	Teledyne Crystalonics 147 Sherman Street Cambridge, MA 02140
13103	Thermalloy Company 2021 W. Valley View Lane Dallas, TX 75234
14632	Watkins-Johnson Company 700 Quince Orchard Road Gaithersburg, MD 20760
14655	Cornell-Dubilier Electronics Div. of Federal Pacific Electric Co. 150 Avenue L Newark, NJ 07101
15442	Mini-Circuits Laboratory Division of Scientific Components Corporation 2913 Quentin Road Brooklyn, NY 11229
15818	Teledyne Semiconductor 1300 Terra Bella Avenue Mountain View, CA 94040
16428	Belden Corporation P. O. Box 1101 Richmond, IN 47374
17856	Siliconix, Inc. 2201 Laurelwood Road Santa Clara, CA 95050
18324	Signetics Corporation 811 East Arques Avenue Sunnyvale, CA 94086
18714	RCA Corporation Solid State Division Fostoria Road Findlay, OH 45840
19209	General Electric Company Battery Business Department P. O. Box 114 Gainsville, FL 32602
19505	Applied Engin. Products, Co. Division of Samarious, Inc. 300 Seymour Avenue Derby, CT 06418
21604	The Buckeye Stamping Co. 555 Marion Road Columbus, OH 43207
25088	Siemens America, Inc. 186 Wood Avenue S. Iselin, NJ 08830
26342	Fiberglass of Ohio Inc. Dayton, Ohio
27014	National Semi-Conductor Corp. 2950 San Ysidro Way Santa Clara, CA 95051
27956	Relcom 3333 Hillview Avenue Palo Alto, CA 94304

Mfr. Code	Name and Address
28480	Hewlett-Packard Company Corporate Headquarters 1501 Page Mill Road Palo Alto, CA 94304
31918	IEE/Schadow Incorporated 8081 Wallace Road Eden Prairie, MN 55343
33095	Spectrum Control, Inc. 152 E. Main Street Fairview, PA 16415
52748	Alpha Components, Inc. 5223 East Simpson Ferry Road Mechanicsburg, PA 17055
56289	Sprague Electric Company Marshall Street North Adams, MA 01247
71279	Cambridge Thermionic Corp. 445 Concord Avenue Cambridge, MA 02138
71400	Bussman Manuafacturing Division of McGraw-Edison Co. 2536 W. University Street St. Louis, MO 63107
71785	TRW Electronic Components Cinch Connector Operations 1501 Morse Avenue Elk Grove Village, IL 60007
72136	Electro Motive Mfg. Co., Inc. South Park & John Streets Willimantic, CT 06226
72982	Erie Technological Products, Incorporated 644 West 12th Street Erie, PA 16512
73138	Beckman Instruments, Inc. Helipot Division 2500 Harbor Boulevard Fullerton, CA 92634
74306	Piezo Crystal Company 100 K Street Carlisle, PA 17013
74868	Bunker Ramo Corporation The Amphenol RF Division 33 East Franklin Street Danbury, CT 06810
75042	TRW Electronic Components IRC Fixed Resistors 401 North Broad Street Philadelphia, PA 19108
75915	Littlefuse, Incorporated 800 E. Northwest Highway Des Plaines, IL 60016
80058	Joint Electronic Type Designation System
80103	Lambda Electronics Corp. Div. of Veeco Instruments, Inc. 515 Broad Hollow Road Melville, NY 11746
80131	Electronic Industries Association 2001 Eye Street, N.W. Washington, D.C. 20006
81349	Military Specifications
81350	Joint Army-Navy Specifications

Mfr. Code	Name and Address
82389	Switchcraft, Incorporated 5555 North Elston Avenue Chicago, IL 60630
84411	TRW Electric Components TRW Capacitors 112 W. First Street Ogallala, NE 69153
88245	Litton Industries USECO Division 13536 Saticoy Street Van Nuys, CA 91409
91293	Johanson Manufacturing Co. P. O. Box 329 Boonton, NJ 07005
91418	Radio Materials Company 4242 West Bryn Mawr Avenue Chicago, IL 60646
91984	Maida Development Company 214 Academy Street Hampton, VA 23369
92825	Whitso Incorporated 9330 Bryon Street Schiller Park, IL 60176
93332	Sylvania Elec. Products, Inc. Semiconductor Products Division 100 Sylvan Road Woburn, MA 01801
93958	Republic Electronics Corp. 176 East 7th Street Paterson, NJ 07524
95121	Quality Components, Inc. P. O. Box 113 St. Mary's, PA 15857
98291	Sealectro Corporation 225 Hoyt Mamaroneck, NY 10544
98978	International Electronic Research Corporation 135 West Magnolia Blvd. Burbank, CA 91502
99800	American Precision Industries Delevan Electronics Division 270 Quaker Road East Aurora, NY 14052
99848	Wilco Corporation 4030 West 10th Street P. O. Box 22248 Indianapolis, IN 46222

5.4 PARTS LIST

The parts list which follows contains all electrical parts used in the equipment and certain mechanical parts which are subject to unusual wear or damage. When ordering replacement parts from Watkins-Johnson Company, specify the type and serial number of the equipment and the reference designation and description of each part ordered. The list of manufacturers provided in paragraph 5.3 and the manufacturer's part number for components are included as a guide to the user of the equipment in the field. These parts may not necessarily agree with the parts installed in the equipment; however, the parts specified in this list will provide satisfactory operation of the equipment. Replacement parts may be obtained from any manufacturer as long as the physical and electrical parameters of the part selected agree with the original indicated part. In the case of components defined by a military or industrial specification, a vendor which can provide the necessary component is suggested as a convenience to the user.

NOTE

As improved semi-conductors become available, it is the policy of Watkins-Johnson to incorporate them in proprietary products. For this reason some transistors, diodes and integrated circuits installed in the equipment may not agree with those specified in the parts list and schematic diagrams of this manual. However, the semi-conductors designated in the manual may be substituted in every case with satisfactory results.

5.5 TYPE WJ-8718 HF RECEIVER, MAIN CHASSIS

REF DESIG	DESCRIPTION		QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	Power Distribution		1	76240	14632	
A2	RF Filter		1	791616	14632	
A3	Input Converter		1	791592	14632	
A4	IF Motherboard		1	791569	14632	
A5	Synthesizer Motherboard		1	791570	14632	
A6	I/O Motherboard		1	791580	14632	
A7*	Manual Tuning Module		1	791874-1	14632	
A8	Frequency Display		1	791578	14632	
A9	BFO Switch		1	791827	14632	
A10	Front Panel Control		1	791684-2	14632	
C1	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V		4	34475-1	14632	
C2	Same as C1					
C3	Same as C1					
C4	Same as C1					
C5	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V		2	34452-1	14632	
C6	Same as C5					
C7	Capacitor, Fixed, Paper: 0.01 µF, 20%, 600 V		6	102P515	56289	
C8 Thru C12	Same as C7					
C13	Capacitor, Variable, Ceramic: 2.5-11 pF, 350 V		1	538-011B2.5-11	72982	
CR1	Diode		2	1N1614	80131	02735
CR2	Same as CR1					
E1	Terminal, Standoff		3	7A1A1	92825	
E2	Same as E1					
E3	Same as E1					
E4	Terminal, Standoff		1	160-2381-01-05-00	71279	
E5	Terminal, Feedthru		4	SFU16Y	04013	
E6	Same as E5					
E7	Same as E5					
E8	Same as E5					
F1	Fuse, Cartridge: 1 AMP, 3 AG Slow-blow		1	MDL1	71400	
F2	Fuse, Cartridge: 1/2 AMP, 3 AG Slow-blow		1	MDL1/2	71400	
FL1	Filter, Power		1	34505-1	14632	
J1	Connector, Plug: SMC Series	Part of W14	8	UG1468/U	80058	19505
J2	Connector, Receptacle		1	205203-1	00779	
J3	Same as J1	Part of W2				
J4	Same as J1	Part of W3				
J5	Same as J1	Part of W4				

* Part of MCM-2 Option.

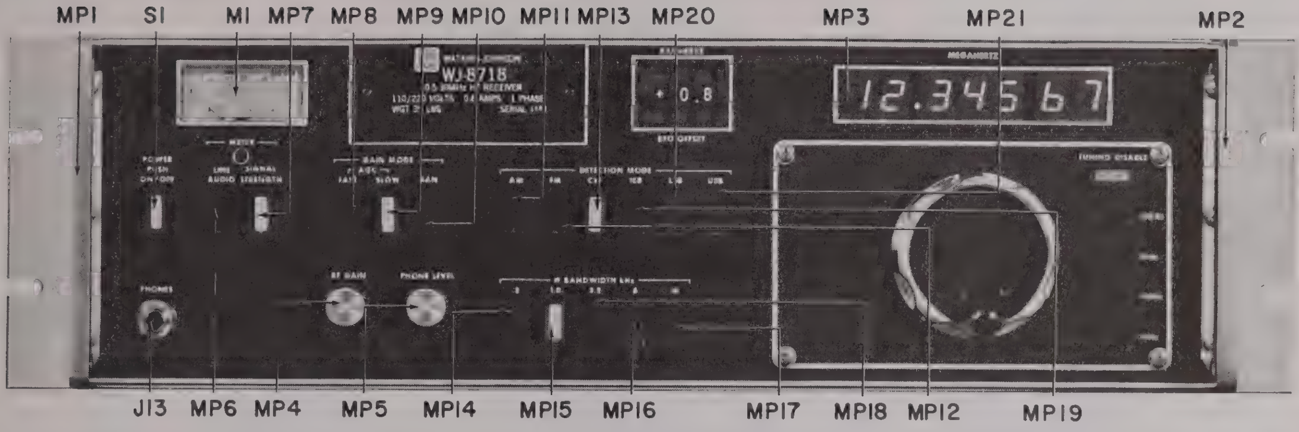


Figure 5-1. WJ-8718 HF Receiver, Front Panel,
Location of Components

* DENOTES HIDDEN PARTS

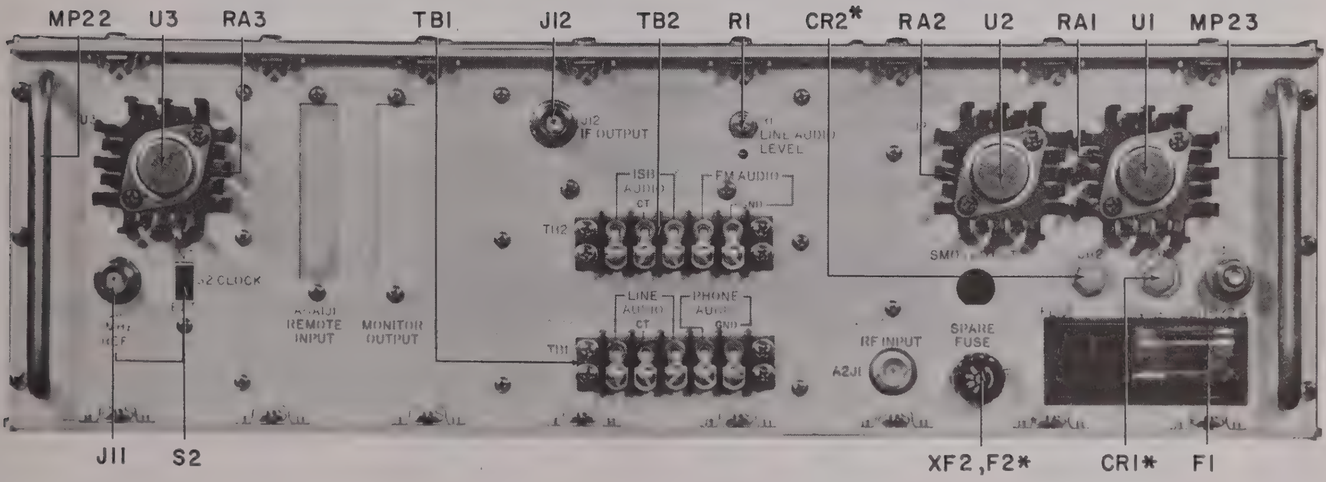
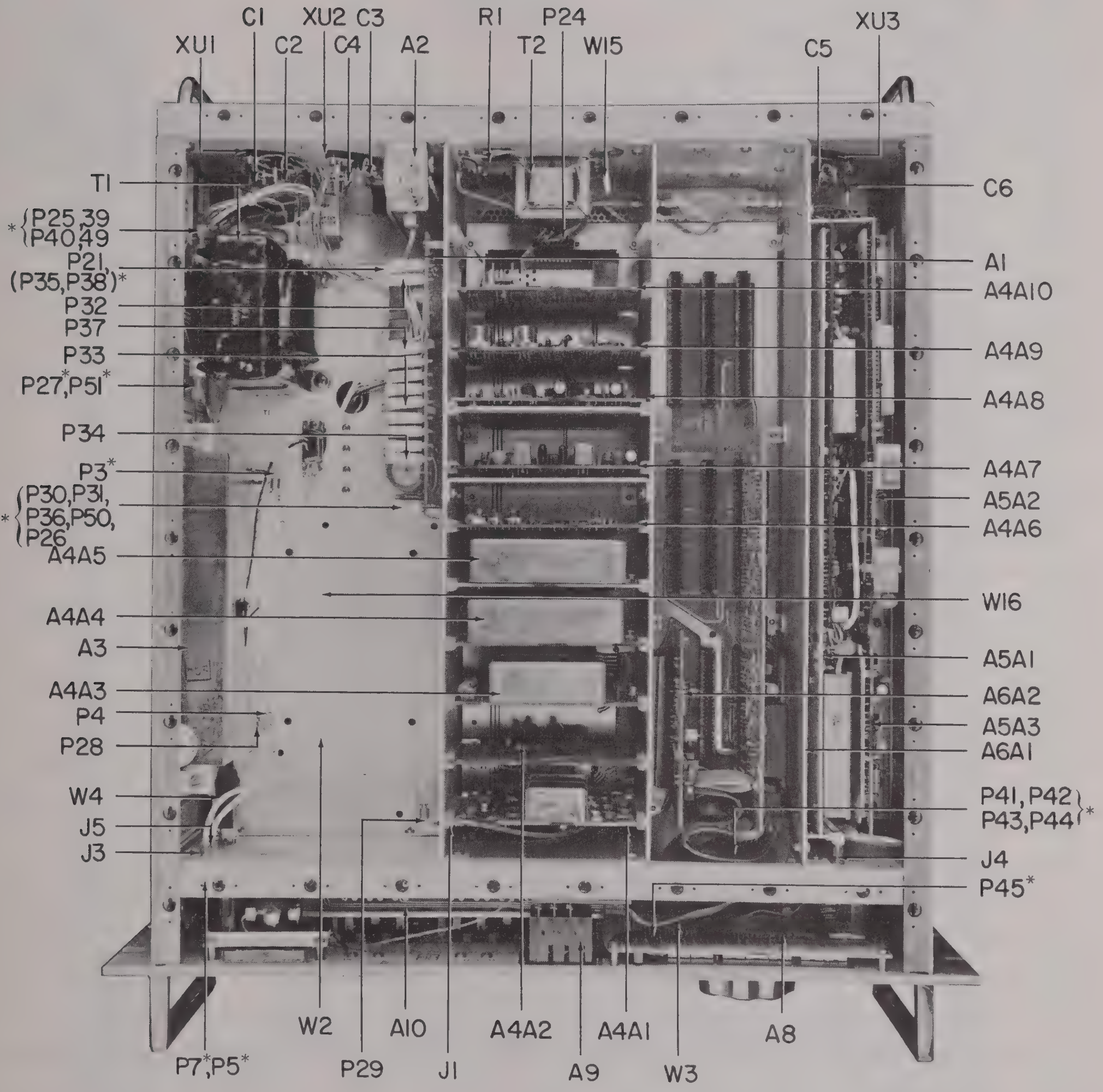


Figure 5-2. WJ-8718 HF Receiver, Rear View,
Location of Components

MAIN CHASSIS

REF DESIG	DESCRIPTION		QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
J6	Connector, Receptacle		1	UG1619	80058	74868
J7	Same as J1	Part of W12				
J8	Same as J1	Part of W13				
J9	Same as J1	Part of W9				
J10	Same as J1	Part of W10				
J11	Connector, Receptacle: BNC Series	Part of W11	2	225398-7	00779	
J12	Same as J11	Part of W15				
J13	Connector, Phone Jack		1	L12B	82389	
L1	Coil, Fixed: 2.2 μH		1	1537-20	99800	
M1	Meter		1	34455-1	14632	
MP1	Handle, Front Panel		2	32306-1	14632	
MP2	Same as MP1					
MP3	Display Window		1	18390-1	14632	
MP4	Knob, Round, Indicator Dot		2	PS70D1/LG	21604	
MP5	Same as MP4					
MP6	Button, Black Shell with Yellow Indicator		16	FA101BLK/YEL	31918	
MP7 Thru MP21	Same as MP6					
MP22	Handle, Round, Rear Panel		2	1012-12	88245	
MP23	Same as MP19					
MP24	Cover Assembly, Top (Not Shown)		1	51201-1	14632	
MP25	Cover Assembly, Bottom (Not Shown)		1	51201-2	14632	
P1	Connector, Plug	Part of W1				
P2	Connector Plug	Part of W1				
P3	Connector, Plug: SMC Series	Part of W2	7	UG1466/U	80058	19505
P4	Same as P3	Part of W4				
P5	Same as P3	Part of W3				
P6	Faston, Receptacle		19	42236-1	00779	
P7	Same as P3	Part of W5				
P8	Same as P3	Part of W5				
P9	Connector, Plug: SMC Series	Part of W6	4	UG1465/U	80058	19505
P10	Same as P9	Part of W6				
P11	Same as P9	Part of W7				
P12	Same as P9	Part of W7				
P13	Plug Assembly		1	34704-1	14632	
P14	Plug Assembly	Part of W9	7	87499-5	00779	
P15	Same as P14	Part of W10				
P16	Same as P14	Part of W11				
P17	Same as P14	Part of W12				
P18	Same as P14	Part of W13				
P19	Same as P14	Part of W14				



*DENOTES HIDDEN PART

Figure 5-3. WJ-8718 HF Receiver, Top View, Location of Components

MAIN CHASSIS

REF DESIG	DESCRIPTION		QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
P20	Same as P14	Part of W15				
P21	Same as P6	Part of W17				
P22	Plug Assembly		1	34529-2	14632	
P23	Plug Assembly		1	34529-3	14632	
P24	Plug Assembly		1	43594-1	14632	
P25	Connector, Plug Faston	Part of W17	11	2-350804-2	00779	
P26	Same as P6	Part of W18				
P27	Same as P25	Part of W18				
P28	Same as P3	Part of W16				
P29	Same as P3	Part of W16				
P30	Same as P6					
P31	Same as P6					
P32	Same as P6	Part of W19				
P33	Same as P6					
P34	Same as P6					
P35	Same as P6					
P36	Same as P6					
P37	Not Used					
P38	Same as P6					
P39	Same as P25					
P40	Same as P25					
P41	Same as P6					
P42	Same as P6					
P43	Same as P6					
P44	Same as P6					
P45	Same as P6					
P46	Same as P6					
P47	Same as P6					
P48	Plug Assembly		1	34529-1	14632	
P49	Same as P25	Part of W19				
P50	Same as P6	Part of W20				
P51	Same as P25	Part of W20				
R1	Resistor, Variable, Composition: 25 kΩ, 10%, 1 W		1	70A3L036L253A	01121	
R2	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W		1	RCR07G221JS	81349	01121
RA1	Radiator, Heat		3	UP2-T03-CB	98978	
RA2	Same as RA1					
RA3	Same as RA1					
S1	Switch, Pushbutton		1	18542	14632	
S2	Switch, Slide		1	11A1211	82389	
T1	Transformer, Power		1	~~34518~~ 380083	14632	
T2	Transformer, Audio		1	841004	14632	

* DENOTES HIDDEN PARTS

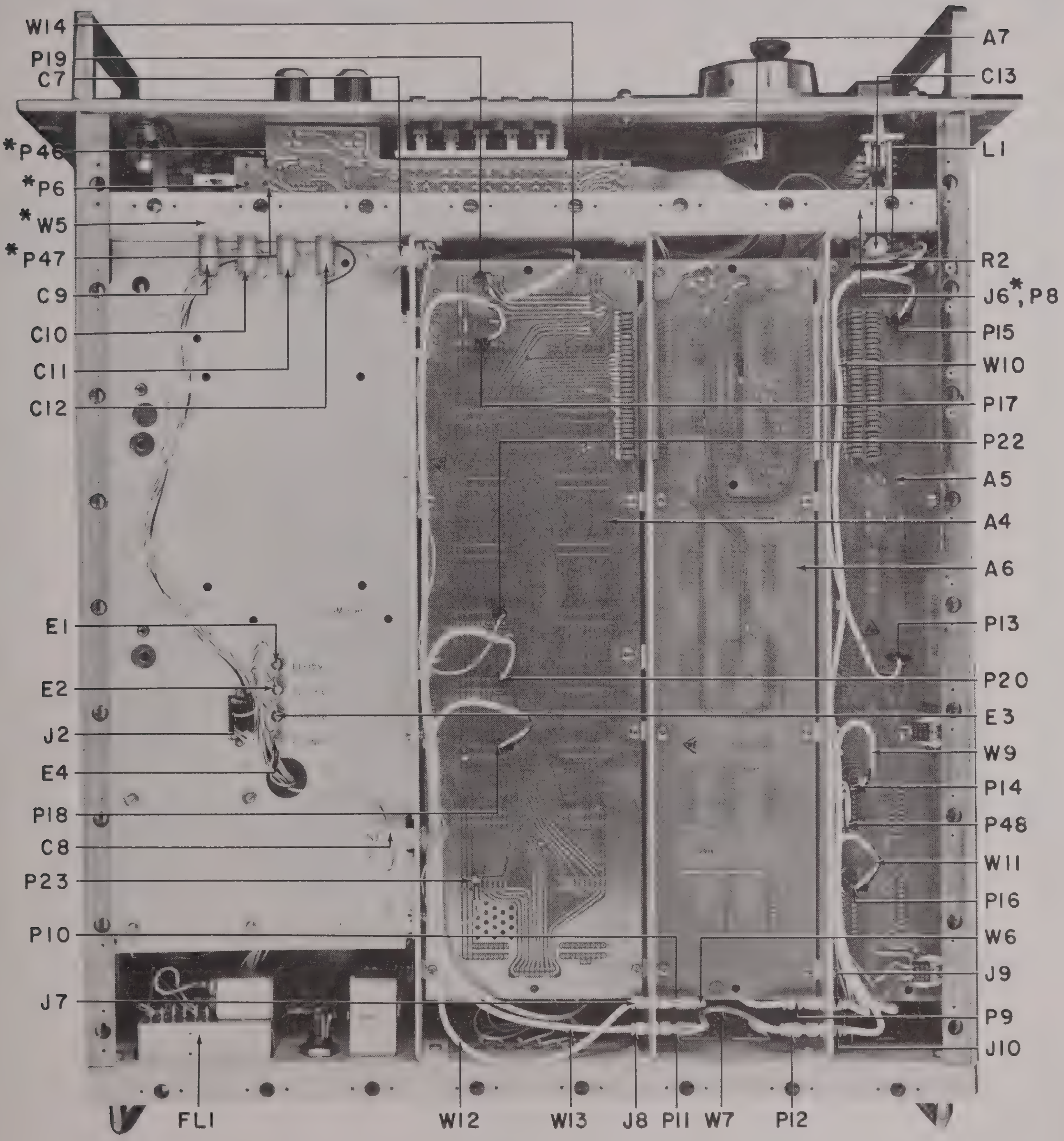


Figure 5-4. WJ-8718 HF Receiver, Bottom View, Location of Components

MAIN CHASSIS

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
TB1	Terminal Board	2	353-18-05-001	71785	
TB2	Same as TB1				
U1	Voltage Regulator	1	LAS1515	80103	
U2	Voltage Regulator	1	LAS1815	80103	
U3	Voltage Regulator	1	LAS1405	80103	
W1	Cable Assembly, Power Line Cord	1	17250	16428	
W2	Cable Assembly	1	34701-1	14632	
W3	Cable Assembly	1	34701-2	14632	
W4	Cable Assembly	1	34701-3	14632	
W5	Cable Assembly	1	34701-4	14632	
W6	Cable Assembly	1	34701-5	14632	
W7	Cable Assembly	1	34701-6	14632	
W8	Not Used				
W9	Cable Assembly	1	34700-1	14632	
W10	Cable Assembly	1	34700-2	14632	
W11	Cable Assembly	1	34702-1	14632	
W12	Cable Assembly	1	34700-3	14632	
W13	Cable Assembly	1	34700-4	14632	
W14	Cable Assembly	1	34700-5	14632	
W15	Cable Assembly	1	34702-2	14632	
W16	Cable Assembly	1	34701-7	14632	
W17	Cable Assembly	1	380005-1	14632	
W18	Cable Assembly	1	380005-2	14632	
W19	Cable Assembly	1	380005-3	14632	
W20	Cable Assembly	1	380005-4	14632	
XF2	Fuseholder	1	342004	75915	
XU1	Socket Assembly	1	34506-1	14632	
XU2	Socket Assembly	1	34506-2	14632	
XU3	Socket Assembly	1	34506-3	14632	

5.5.1 TYPE 76240 POWER DISTRIBUTION REF DESIG PREFIX A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Electrolytic, Aluminum: 2200 μF, -10+75%, 25 V	2	39D228G025HP4	56289	
C2	Same as C1				
C3	Capacitor, Electrolytic, Aluminum: 8000 μF, -10+75%, 15 V	2	39D808G015JT4	56289	
C4	Same as C3				
CR1	Diode	4	1N4998	80131	04713
CR2 Thru CR4	Same as CR1				
J1	Faston Tab	20	62073-1	00779	
J2 Thru J14	Same as J1				
J15 Thru J18	Not Used				
J19	Same as J1				
J20	Same as J1				
J21	Same as J1				
J22 Thru J30	Not Used				
J31	Same as J1				
J32	Same as J1				
J33	Not Used				
J34	Not Used				
J35	Same as J1				

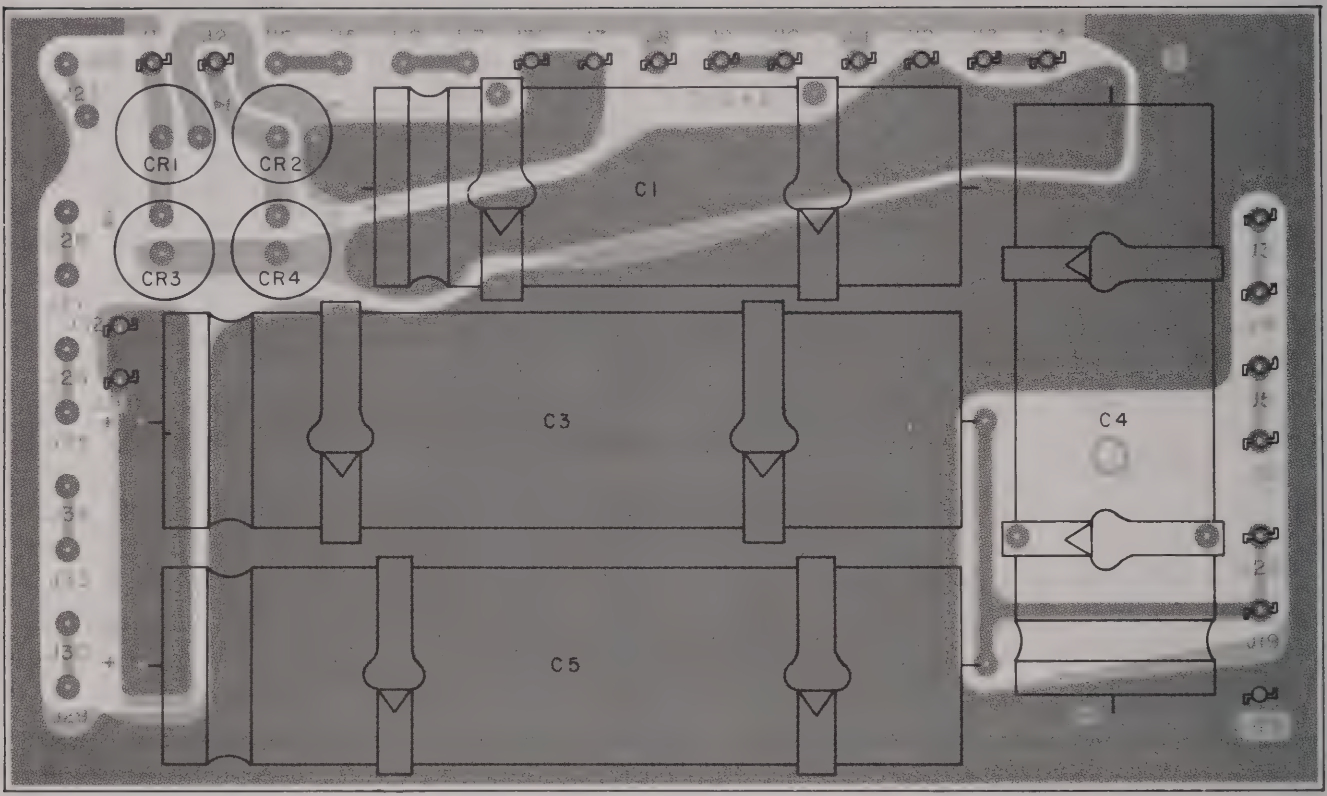


Figure 5-5. Type 76240 Power Distribution (A1), Location of Components

5.5.2 TYPE 791616 RF FILTER REF DESIG PREFIX A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 100 V	2	8131M100-651-474M	72982	
C2	Same as C1				
C3	Capacitor, Mica, Dipped: 20 pF, 5%, 500 V	1	CM05ED200J03	81349	72136
C4	Capacitor, Mica, Dipped: 68 pF, 2%, 500 V	1	CM05ED680G03	81349	72136
C5	Capacitor, Mica, Dipped: 180 pF, 2%, 500 V	3	CM05FD181G03	81349	72136
C6	Capacitor, Mica, Dipped: 180 pF, 2%, 500 V	3	CM05FD181G03	81349	72136
C7	Same as C5				
C8	Same as C6				
C9	Capacitor, Mica, Dipped: 27 pF, 2%, 500 V	1	CM05ED270G03	81349	72136
C10	Same as C6				
C11	Capacitor, Mica, Dipped: 15 pF, 5%, 500 V	2	CM05CD150J03	81349	72136
C12	Capacitor, Mica, Dipped: 200 pF, 2%, 500 V	2	CM05FD201G03	81349	72136
C13	Capacitor, Mica, Dipped: 220 pF, 2%, 500 V	1	CM05FD221G03	81349	72136
C14	Same as C11				
C15	Same as C12				
C16	Capacitor, Mica, Dipped: 120 pF, 2%, 500 V	1	CM05FD121G03	81349	72136
C17	Capacitor, Mica, Dipped: 47 pF, 2%, 500 V	1	CM05ED470G03	81349	72136
CR1	Diode	2	1N4449	80131	93332
CR2	Same as CR1				
E1	Connector, Termination	1	144/188	19505	
J1	Connector, Receptacle: BNC Series	1	UG1094/U	80058	74868
L1	Coil, Toroidal	2	20681-186	14632	
L2	Coil, Toroidal	1	20681-187	14632	
L3	Same as L1				
L4	Coil, Toroidal	2	20681-188	14632	
L5	Coil, Toroidal	2	20681-189	14632	
L6	Same as L5				
L7	Same as L4				
L8	Inductor	1	21209-37	14632	
P1	Connector, Plug: SMC Series	1	UG1466/U	19505	
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	1	RCR07G103JS	81349	01121
VR1	Diode, Zener: 6.2 V	2	1N753A	80131	04713
VR2	Same as VR1				

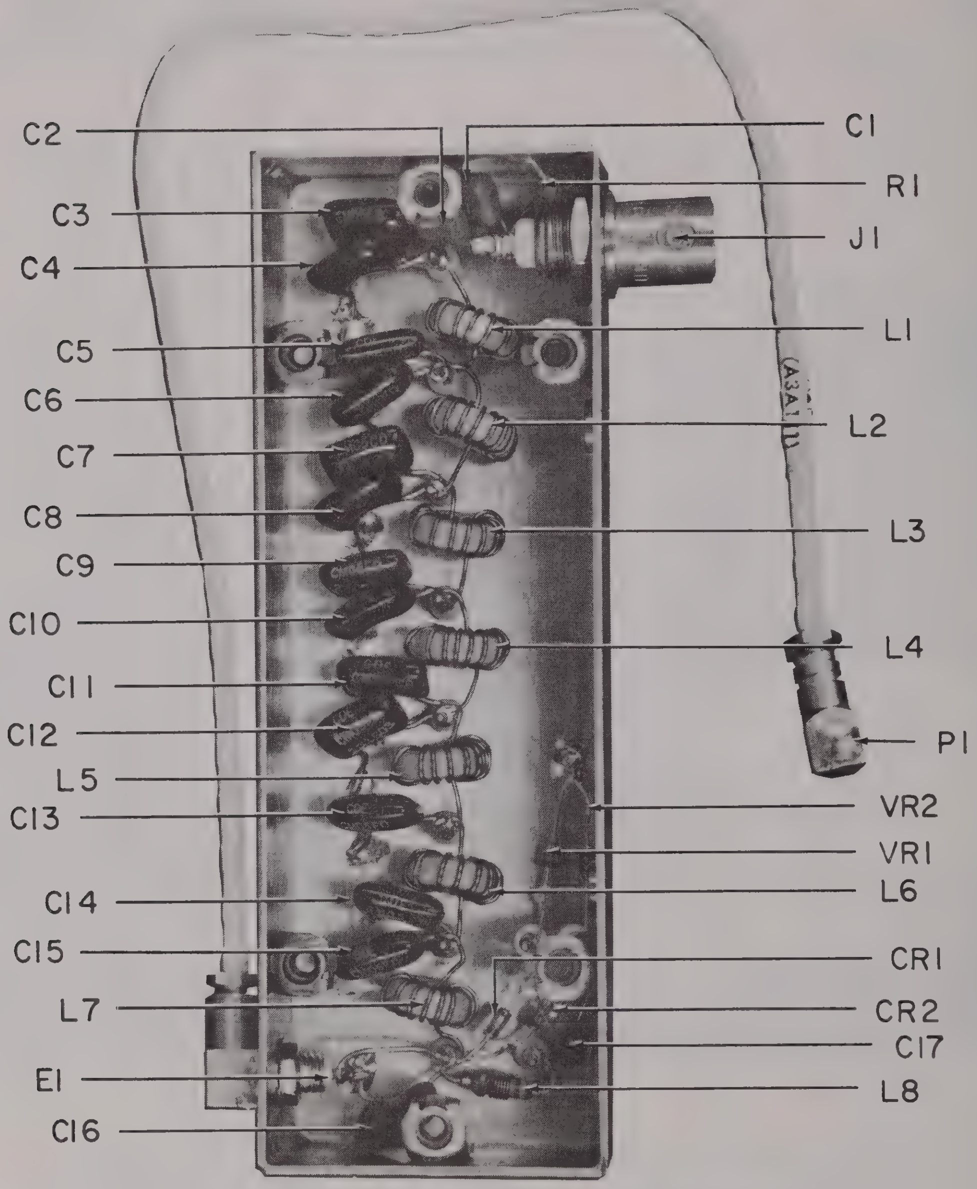


Figure 5-6. Type 791616 RF Filter (A2),
Location of Components

5.5.2A TYPE 791616 INPUT FILTER REF DESIG PREFIX A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	30 MHz Low Pass Filter	1	280093	14632	
E1	Connector, Termination	1	144/188	19505	
J1	Connector, Receptacle, BNC Series	1	UG1094/U	80058	74868
L1	Coil, Toroidal	1	20681-208	14632	
P1	Connector, Plug, SMC Series	1	UG1466/U	80058	19505

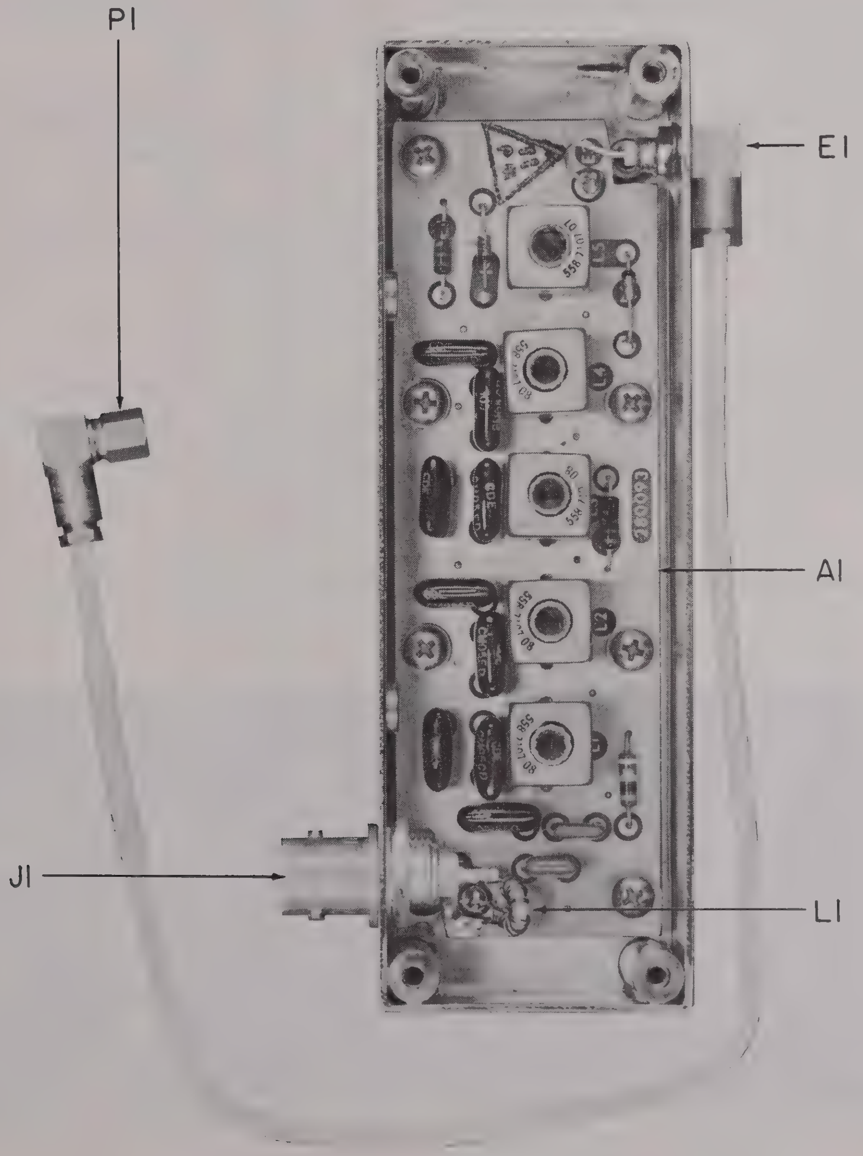


Figure 5-6A. Type 791616 Input Filter (Product Improvement) A2, Location of Components

5.5.2B Part 280093 30 MHz Low Pass Filter REF DESIG PREFIX A2A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	2	34452-1	14632	
C2	Capacitor, Mica, Dipped: 120 pF, 2%, 500 V	1	CM05FD121G03	81349	72136
C3	Capacitor, Mica, Dipped: 10 pF, ±0.5 pF, 500 V	1	CM05CD100D03	81349	72136
C4	Capacitor, Mica, Dipped: 180 pF, 2%, 500 V	1	CM05FD181G03	81349	72136
C5	Capacitor, Mica, Dipped: 33 pF, 2%, 500 V	1	CM05ED330G03	81349	72136
C6	Capacitor, Mica, Dipped: 150 pF, 2%, 500 V	3	CM05FD151G03	81349	72136
C7	Capacitor, Mica, Dipped: 39 pF, 2%, 500 V	1	CM05ED390G03	81349	72136
C8	Same as C6				
C9	Capacitor, Mica, Dipped: 18 pF, 5%, 500 V	1	CM05CD180G03	81349	72136
C10	Same as C6				
C11	Same as C1				
C12	Capacitor, Ceramic, Disc: 47 pF, 5%, 100 V	1	8111-100C0G0-470J	72982	
CR1	Diode	2	1N4449	80131	93332
CR2	Same as CR1				
L1	Coil, Variable: 0.351-0.429 µH	4	558-7107-08	71279	
L2	Same as L1				
L3	Same as L1				
L4	Same as L1				
L5	Coil, Variable: 0.297-0.363 µH	1	558-7107-07	71279	
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	1	RCR07G103JS	81349	01121
VR1	Diode, Zener: 6.2 V	2	1N753A	80131	04713
VR2	Same as VR1				

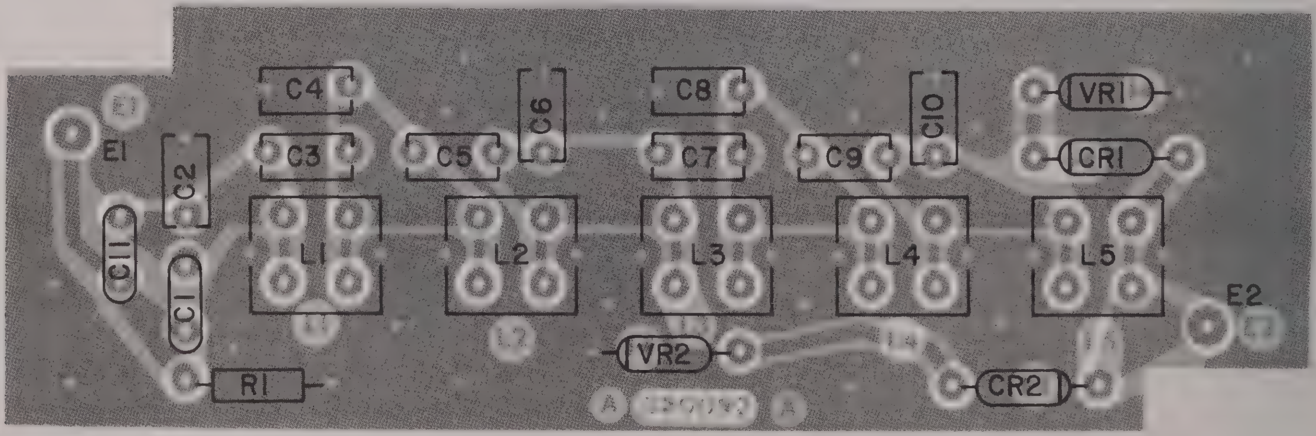


Figure 5-6B. Part 280093 30 MHz Low Pass Filter (Product Improvement) A2A1, Location of Components

THIS PAGE LEFT BLANK

5.5.3 TYPE 791592-1 INPUT CONVERTER REF DESIG PREFIX A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	1st Mixer, 1st IF	1	34748	14632	
A2	2nd Mixer, 2nd IF	1	34749	14632	
A3	Filter Board	1	280080	14632	
C1	Capacitor, Ceramic, Feedthru: 1000 pF, GMV, 500 V	4	54-794-009-102W	33095	
C2 Thru C4	Same as C1				
L1	Coil, Fixed: 1.8 µH	1	1537-18	99800	
P1	Connector, Plug: HDP-20	1	205204-1	00779	

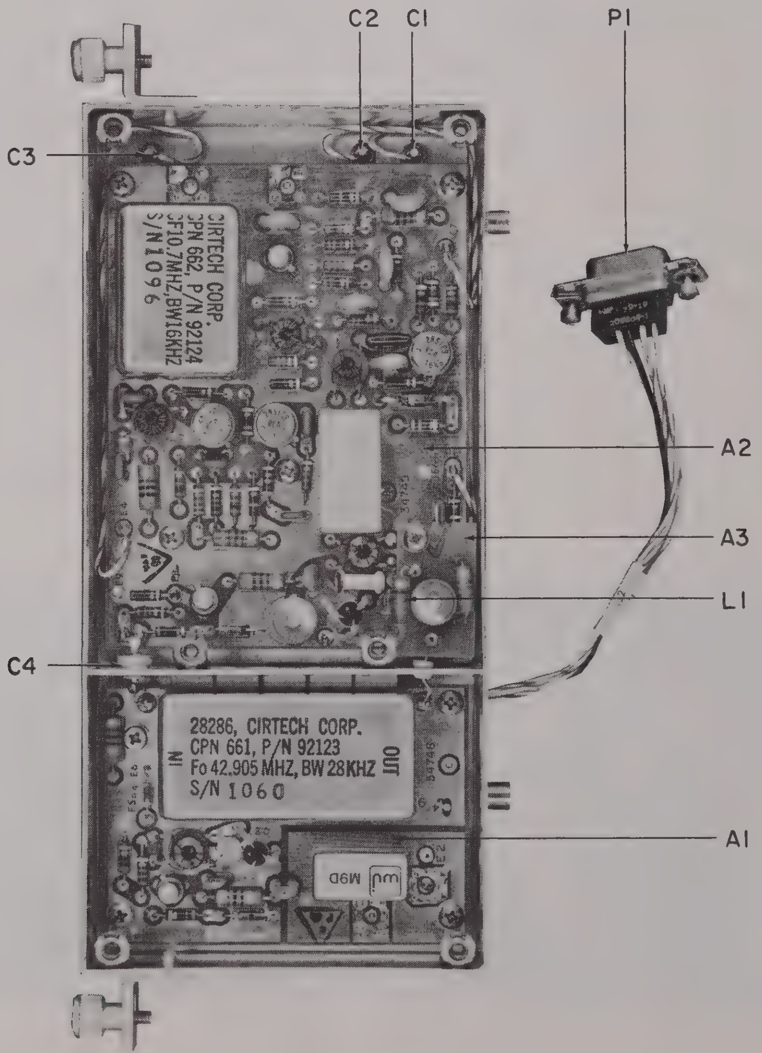


Figure 5-7. Type 791592-1 Input Converter (A3), Location of Components

5.5.3.1 Part 34748 1st Mixer, 1st IF

REF DESIG PREFIX A3A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 1000 pF, GMV, 500 V	2	SM1000PFP	91418	
C2	Same as C1				
C3	Capacitor, Variable, Ceramic: 2.5-9 pF, 25 V	1	518-000A2.5-9	72982	
CR1	Diode	1	1N4446	80131	93332
FL1	Filter, Bandpass: 43 MHz	1	92123	14632	
J1	Connector, Receptacle: SMC Series	2	34520-1	14632	
J2	Same as J1				
L1	Coil, Fixed: 10 µH	2	1537-36	99800	
L2	Same as L1				
Q1	Transistor	1	2N2222A	80131	04713
Q2	Transistor	1	CP643	12498	
R1	Resistor, Fixed, Composition: 2.2 kΩ, 5%, 1/4 W	1	RCR07G222JS	81349	01121
R2	Resistor, Fixed, Composition: 82 Ω, 5%, 1/4 W	1	RCR07G820JS	81349	01121
R3	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	1	RCR07G100JS	81349	01121
R4*	Resistor, Fixed, Composition: 150 Ω, 5%, 1/8 W	1	RCR05G151JS	81349	01121
RA1	Heatsink	1	1118C	13103	
T1	Transformer Assembly	1	22295-52	14632	
U1	Mixer, Balanced	1	M9D	27956	
	* Nominal value, final value factory selected.				

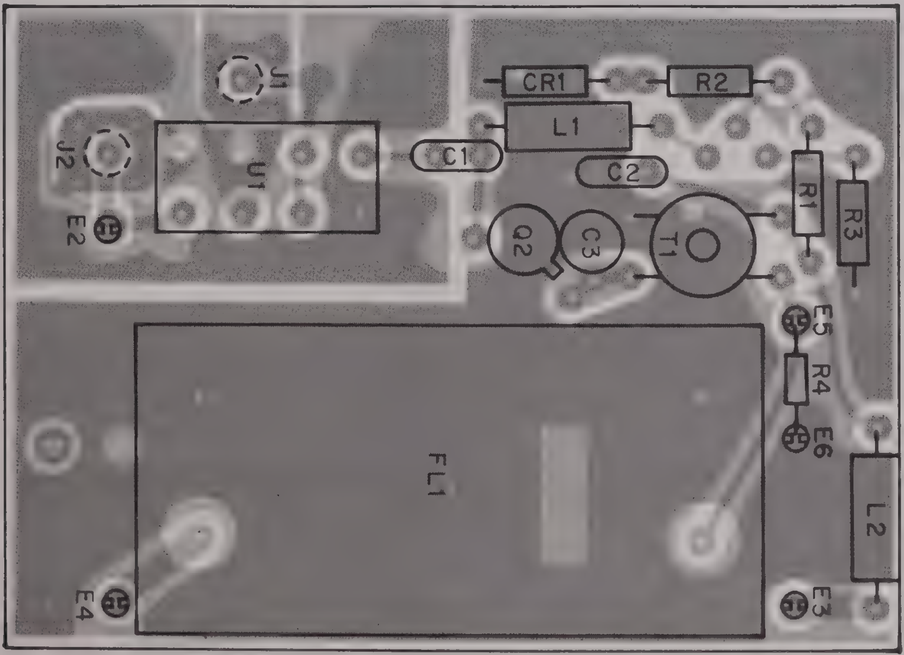


Figure 5-8. Part 34748 1st Mixer, 1st IF (A3A1), Location of Components

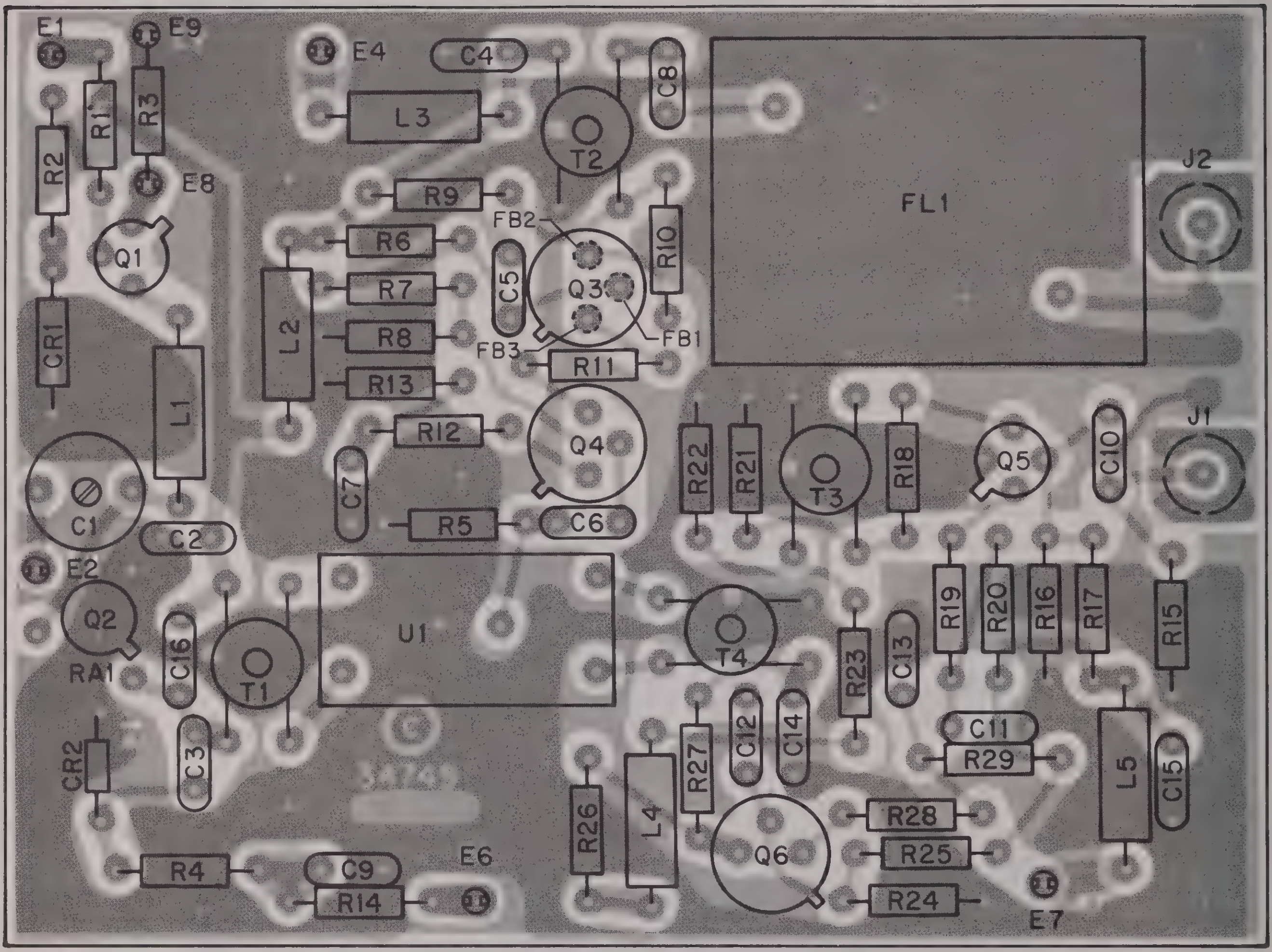


Figure 5-9. Part 34749 2nd Mixer/2nd IF Amplifier (A3A2), Location of Components

5.5.3.2 Part 34749 2nd Mixer/2nd IF Amplifier REF DESIG PREFIX A3A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Variable, Ceramic: 2.5-11 pF, 350 V	1	538-011B2.5-11	72982	
C2	Capacitor, Ceramic, Disc: 1000 pF, GMV, 500 V	2	SM1000PFP	91418	
C3	Same as C2				
C4	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	5	34453-1	14632	
C5 Thru C8	Same as C4				
C9	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V	1	34475-1	14632	
C10	Capacitor, Ceramic, Disc: 470 pF, 20%, 1000 V	5	B470PFM	91418	
C11 Thru C13	Same as C10				
C14	Capacitor, Mica, Dipped: 47 pF, 2%, 500 V	1	CM05ED470G03	81349	72136
C15	Same as C10				
C16	Capacitor, Ceramic, Tubular: 4.7 pF, ±0.1 pF, 500 V	1	301-000C0H0-479B	72982	
CR1	Diode	1	1N4446	80131	93332
CR2	Diode	1	5082-3039	28480	
FB1	Ferrite Bead	3	56-590-65-4A	02114	
FB2	Same as FB1				
FB3	Same as FB1				
FL1	Filter, Bandpass: 10.7 MHz CF, 16 kHz BW	1	92124	14632	
J1	Connector, Receptacle: SMC Series	2	34520-1	14632	
J2	Same as J1				
L1	Coil, Fixed: 10 µH	4	1537-36	99800	
L2	Same as L1				
L3	Same as L1				
L4	Coil, Fixed: 0.56 µH	1	202-11	99848	
L5	Same as L1				
Q1	Transistor	1	2N2222A	80131	04713
Q2	Transistor	1	CP643	12498	
Q3	Transistor	3	2N5109	80131	02735
Q4	Same as Q3				
Q5	Transistor	1	2N2857	80131	02735
Q6	Same as Q3				
R1	Resistor, Fixed, Composition: 2.2 kΩ, 5%, 1/4 W	2	RCR07G222JS	81349	01121
R2	Resistor, Fixed, Composition: 82 Ω, 5%, 1/4 W	1	RCR07G820JS	81349	01121
R3*	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	4	RCR07G100JS	81349	01121
R4	Resistor, Fixed, Composition: 1.8 kΩ, 5%, 1/4 W	1	RCR07G182JS	81349	01121
R5	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	2	RCR07G221JS	81349	01121
R6	Resistor, Fixed, Composition: 3.3 kΩ, 5%, 1/4 W	1	RCR07G332JS	81349	01121
	* Nominal value, final value factory selected.				

REF DESIG PREFIX A3A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R7	Same as R1				
R8	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	3	RCR07G102JS	81349	01121
R9	Resistor, Fixed, Composition: 200 Ω, 5%, 1/4 W	1	RCR07G201JS	81349	01121
R10	Same as R3				
R11	Resistor, Fixed, Composition: 47 Ω, 5%, 1/4 W	1	RCR07G470JS	81349	01121
R12	Resistor, Fixed, Composition: 4.7 Ω, 5%, 1/4 W	1	RCR07G4R7JS	81349	01121
R13	Resistor, Fixed, Composition: 68 Ω, 5%, 1/4 W	2	RCR07G680JS	81349	01121
R14	Resistor, Fixed, Composition: 390 Ω, 5%, 1/4 W	1	RCR07G391JS	81349	01121
R15	Same as R13				
R16	Resistor, Fixed, Composition: 2.7 kΩ, 5%, 1/4 W	1	RCR07G272JS	81349	01121
R17	Same as R8				
R18	Same as R3				
R19	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	1	RCR07G220JS	81349	01121
R20	Same as R5				
R21	Resistor, Fixed, Composition: 560 Ω, 5%, 1/4 W	1	RCR07G561JS	81349	01121
R22	Resistor, Fixed, Composition: 150 Ω, 5%, 1/4 W	2	RCR07G151JS	81349	01121
R23	Resistor, Fixed, Composition: 15 Ω, 5%, 1/4 W	1	RCR07G150JS	81349	01121
R24	Same as R8				
R25	Resistor, Fixed, Composition: 470 Ω, 5%, 1/4 W	1	RCR07G471JS	81349	01121
R26	Resistor, Fixed, Composition: 330 Ω, 5%, 1/4 W	1	RCR07G331JS	81349	01121
R27	Same as R3				
R28	Resistor, Fixed, Composition: 12 Ω, 5%, 1/4 W	1	RCR07G120JS	81349	01121
R29	Same as R22				
RA1	Heatsink	1	1118C	13103	
T1	Transformer Assembly	1	22295-53	14632	
T2	Transformer Assembly	1	22295-54	14632	
T3	Transformer Assembly	1	22295-56	14632	
T4	Transformer Assembly	1	22295-55	14632	
U1	Mixer, Balanced: 0.05-200 MHz	1	GRA-3H	15542	

5.5.3.3 Part 280080 Filter Board

REF DESIG PREFIX A3A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Variable, Ceramic: 9-35 pF, 350 V	1	538-011D9-35	72982	
L1	Coil, Fixed: 0.33 μH	1	1537-04	99800	

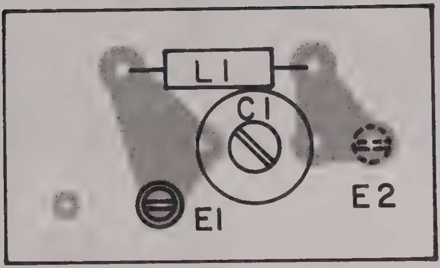


Figure 5-10. Part 280080 Filter Board (A3A3), Location of Components

5.5.4 TYPE 791569 IF MOTHERBOARD REF DESIG PREFIX A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	10.7 MHz Filter Switch	1	791594	14632	
A2	10.7 MHz/455 kHz Converter	1	71430	14632	
A3	455 kHz Filter Switch	1	791595	14632	
A4*	USB Filter Switch	1	791596	14632	
A5*	ISB, LSB Filter Switch	1	791597	14632	
A6	AGC Amplifier	1	78112	14632	
A7	455 kHz Amplifier/AM Detector	1	72488	14632	
A8*	ISB Detector/Audio	1	791598	14632	
A9	FM, CW, & SSB Detector	1	791599	14632	
A10	Audio Amplifier	1	7459	14632	
A11	Spare				
C1	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	29	34453-1	14632	
C2 Thru C29	Same as C1				
J1	Feedthru Post	2	PE914031-2	00779	
J2	Same as J1				
L1	Ferrite Choke	2	VK200-10-3B	02114	
L2	Same as L1				
MP1	Housing, P.C. Connector	11	117798-3	00779	
MP2 Thru MP11	Same as MP1				
- -	Cable Assembly	1	34832	14632	
P1	Plug Assembly	1	88523-1	00779	
XA1	Contact Strip	11	PE7-14046	00779	
XA2 Thru XA11	Same as XA1				
	* Part of ISB Option.				

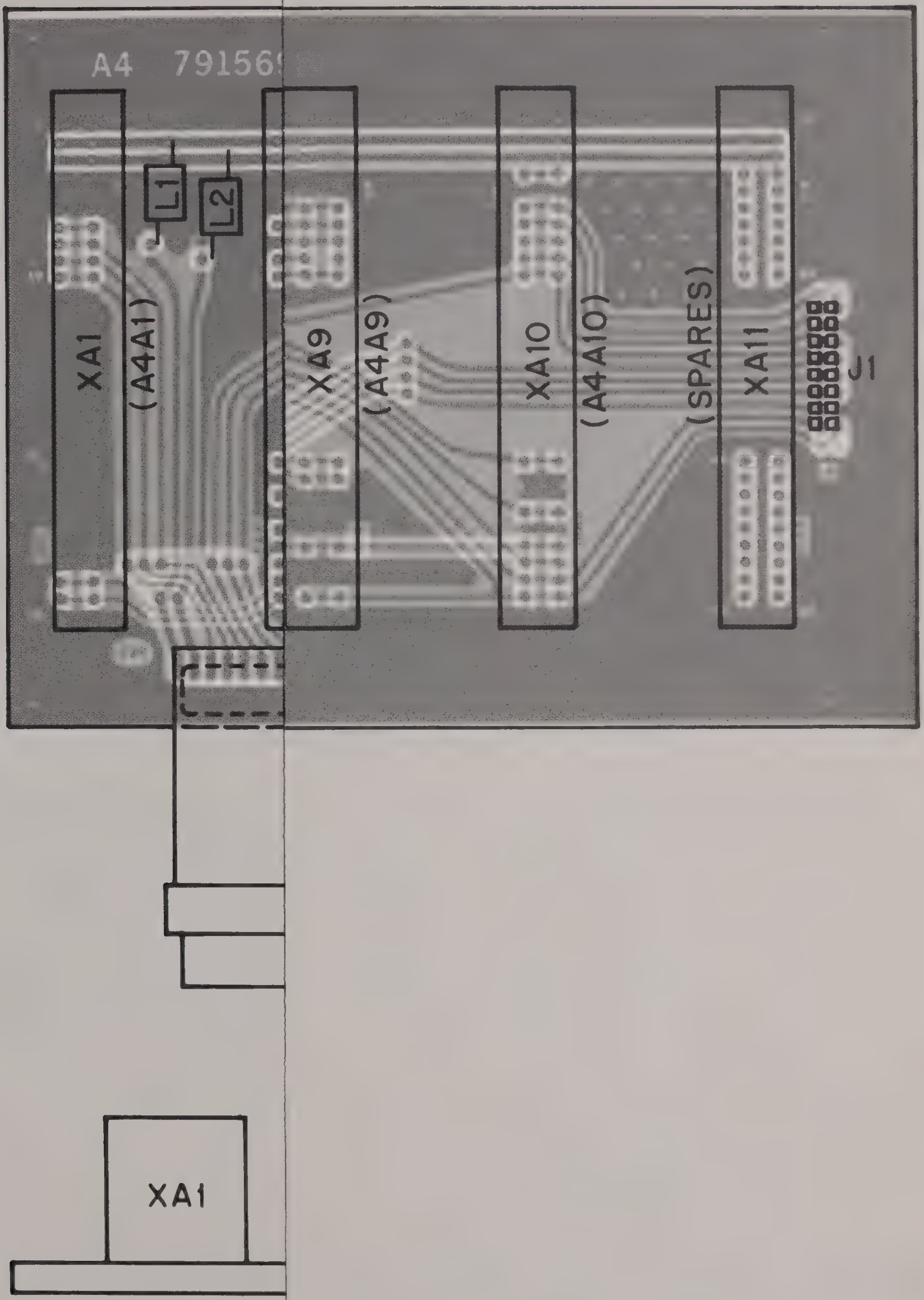


Figure 5-11. Type 791569 IF Motherboard (A4),
Location of Components

5.5.4 TYPE 791569 IF MOTHERBOARD REF DESIG PREFIX A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	10.7 MHz Filter Switch	1	791594	14632	
A2	10.7 MHz/455 kHz Converter	1	71430	14632	
A3	455 kHz Filter Switch	1	791595	14632	
A4*	USB Filter Switch	1	791596	14632	
A5*	ISB, LSB Filter Switch	1	791597	14632	
A6	AGC Amplifier	1	78112	14632	
A7	455 kHz Amplifier/AM Detector	1	72488	14632	
A8*	ISB Detector/Audio	1	791598	14632	
A9	FM, CW, & SSB Detector	1	791599	14632	
A10	Audio Amplifier	1	7459	14632	
A11	Spare				
C1	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	29	34453-1	14632	
C2 Thru C29	Same as C1				
J1	Feedthru Post	2	PE914031-2	00779	
J2	Same as J1				
L1	Ferrite Choke	2	VK200-10-3B	02114	
L2	Same as L1				
MP1	Housing, P.C. Connector	11	117798-3	00779	
MP2 Thru MP11	Same as MP1				
- -	Cable Assembly	1	34832	14632	
P1	Plug Assembly	1	88523-1	00779	
XA1	Contact Strip	11	PE7-14046	00779	
XA2 Thru XA11	Same as XA1				
	* Part of ISB Option.				

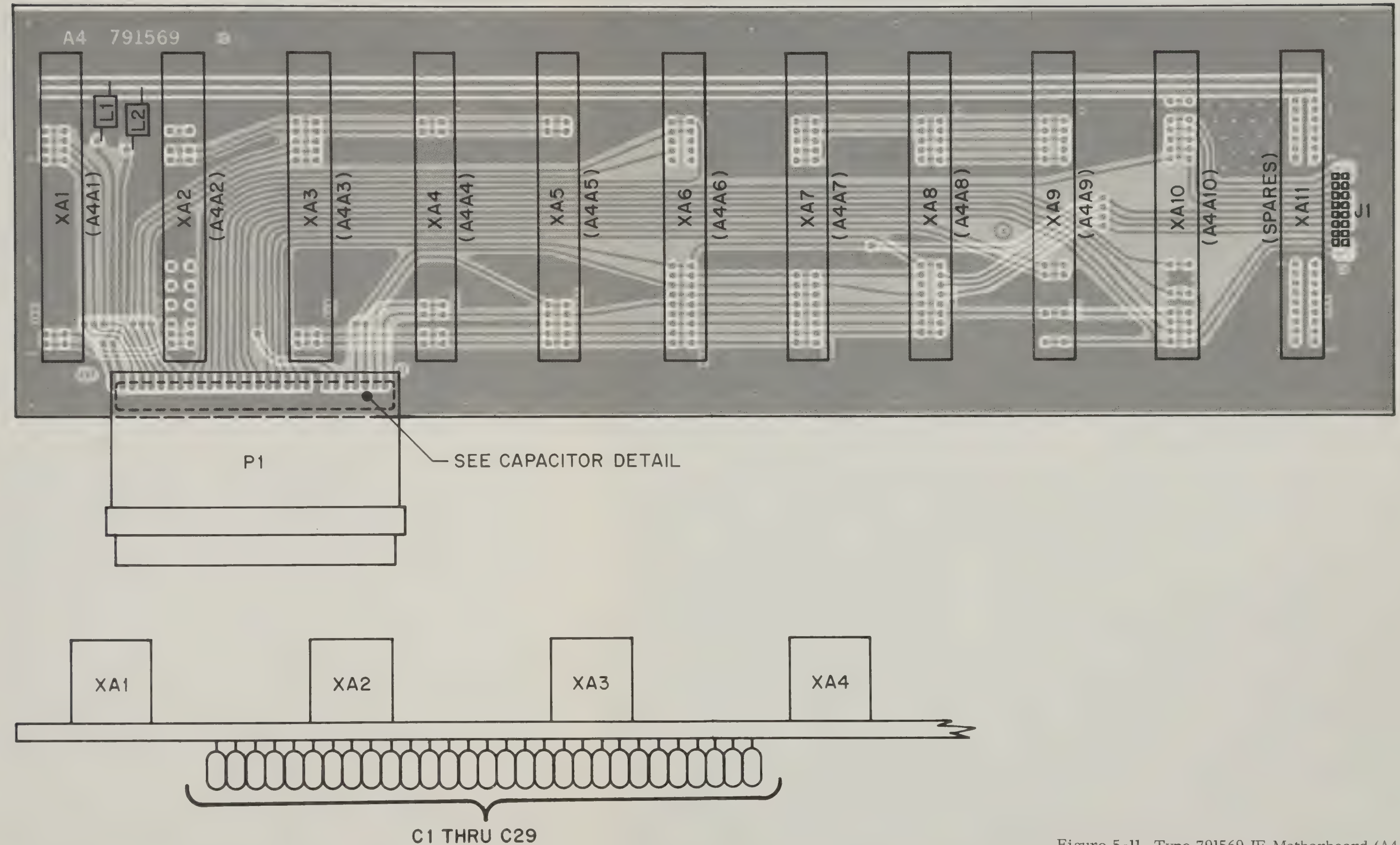


Figure 5-11. Type 791569 IF Motherboard (A4), Location of Components

5.5.4.1 Type 791594 10.7 MHz Filter Switch REF DESIG PREFIX A4A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 50 V	28	34453-1	14632	
C2 Thru C8	Same as C1				
C9	Capacitor, Electrolytic, Tantalum: 15 μF, 10%, 20 V	1	CS13BE156K	81349	56289
C10	Same as C1				
C11	Same as C1				
C12	Not Used				
C13 Thru C30	Same as C1				
C31	Capacitor, Mica, Dipped: 68 pF, 2%, 500 V	1	CM05ED680G03	81349	72136
C32	Capacitor, Mica, Dipped: 130 pF, 2%, 500 V	1	CM05FD131G03	81349	72136
C33	Capacitor, Mica, Dipped: 51 pF, 2%, 500 V	2	CM05ED510G03	81349	01121
C34	Same as C33				
FL1	Filter, Bandpass: 3.2 kHz BW	1	92126	14632	
FL2	Filter, Bandpass: 6 kHz BW	1	92125	14632	
L1	Coil, Fixed: 33 μH	1	1537-52	99800	
L2	Coil, Fixed: 2.2 μH	1	1537-20	99800	
L3	Coil, Fixed: 1.8 μH	1	1537-18	99800	
Q1	Transistor (3N187)	6	841001-1	14632	
Q2 Thru Q6	Same as Q1				
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	10	RCR07G103JS	81349	01121
R2	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	3	RCR07G122JS	81349	01121
R3	Resistor, Fixed, Composition: 470 kΩ, 5%, 1/4 W	9	RCR07G474JS	81349	01121
R4	Resistor, Fixed, Composition: 820 Ω, 5%, 1/4 W	2	RCR07G821JS	81349	01121
R5	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	6	RCR07G100JS	81349	01121
R6	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	5	RCR07G220JS	81349	01121
R7	Resistor, Variable, Film: 200 Ω, 10%, 1/2 W	3	62PR200	73138	
R8	Same as R3				
R9	Same as R1				
R10	Same as R6				
R11	Same as R3				
R12	Resistor, Fixed, Composition: 56 Ω, 5%, 1/4 W	1	RCR07G560JS	81349	01121
R13	Same as R5				
R14	Resistor, Fixed, Composition: 68 Ω, 5%, 1/4 W	6	RCR07G680JS	81349	01121
R15	Same as R6				
R16	Same as R6				
R17	Same as R1				
R18	Same as R3				
R19	Same as R5				

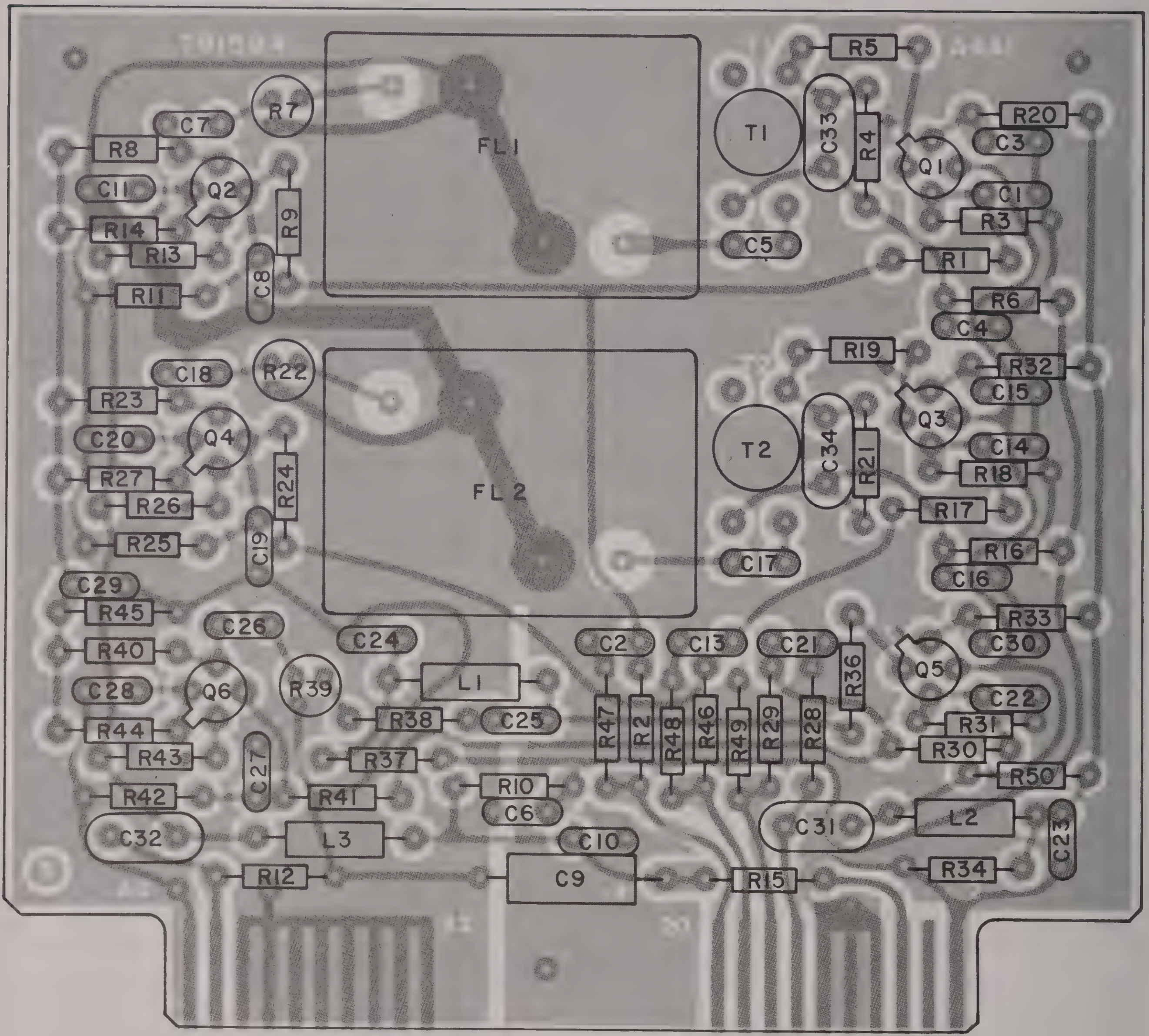


Figure 5-12. Type 791594 10.7 MHz Filter Switch (A4A1), Location of Components

REF DESIG PREFIX A4A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R20	Same as R14				
R21	Same as R4				
R22	Same as R7				
R23	Same as R3				
R24	Same as R1				
R25	Same as R3				
R26	Same as R5				
R27	Same as R14				
R28	Same as R1				
R29	Same as R2				
R30	Same as R1				
R31	Same as R3				
R32	Same as R14				
R33	Same as R14				
R34	Resistor, Fixed, Composition: 180 Ω, 5%, 1/4 W	2	RCR07G181JS	81349	01121
R35	Not Used				
R36	Same as R5				
R37	Same as R6				
R38	Resistor, Fixed, Composition: 200 Ω, 5%, 1/4 W	1	RCR07G201JS	81349	01121
R39	Same as R7				
R40	Same as R3				
R41	Same as R1				
R42	Same as R3				
R43	Same as R5				
R44	Same as R14				
R45	Same as R34				
R46	Same as R2				
R47 Thru R49	Same as R1				
R50	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	1	RCR07G102JS	81349	01121
T1	Transformer	2	70449	52748	
T2	Same as T1				

5.5.4.1A TYPE 791594 10.7 MHz FILTER SWITCH REF DESIG PREFIX A4A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Mica, Dipped: 130 pF, 2%, 500 V	1	CM05FD131G03	81349	72136
C2	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 50 V	18	34453-1	14632	
C3 Thru C8	Same as C2				
C9	Capacitor, Ceramic, Disc: 0.1 μF, 20%, 50 V	8	34475-1	14632	
C10	Same as C2				
C11	Same as C9				
C12	Same as C2				
C13	Same as C9				
C14	Same as C2				
C15	Same as C9				
C16	Same as C9				
C17	Capacitor, Mica, Dipped: 33 pF, 2%, 500 V	1	CM05ED330G03	81349	72136
C18 Thru C23	Same as C2				
C24	Same as C9				
C25	Same as C9				
C26	Same as C9				
C27	Capacitor, Electrolytic, Tantalum: 15 μF, 10%, 20 V	2	CS13BE156K	81349	56289
C28	Same as C2				
C29	Same as C2				
C30	Capacitor, Mica, Dipped: 130 pF, 2%, 500 V	1	CM05FD131G03	81349	72136
C31	Same as C27				
FL1	Filter, Bandpass	1	92126	14632	
FL2	Filter, Bandpass	1	92125	14632	
L1	Coil, Fixed: 1 μH	1	1537-12	99800	
L2	Not Used				
L3	Not Used				
L4	Coil, Fixed: 8.2 μH	1	1537-34	99800	
L5	Coil, Fixed: 1.8 μH	1	1537-18	99800	
MP1	Transipad	6	7717-44DAP	13103	
MP2 Thru MP6	Same as MP1				
Q1	Transistor	6	2N2222A	80131	04713
Q2 Thru Q6	Same as Q1				
R1	Resistor, Fixed, Composition: 13 kΩ, 5%, 1/4 W	3	RCR07G133JS	81349	01121
R2	Resistor, Fixed, Composition: 3 kΩ, 5%, 1/4 W	3	RCR07G302JS	81349	01121
R3	Same as R1				

REF DESIG PREFIX A4A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R4	Same as R2				
R5	Same as R1				
R6	Same as R2				
R7	Resistor, Fixed, Composition: 680 Ω, 5%, 1/4 W	3	RCR07G681JS	81349	01121
R8	Same as R7				
R9	Same as R7				
R10	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	6	RCR07G100JS	81349	01121
R11	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	2	RCR07G221JS	81349	01121
R12	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	5	RCR07G220JS	81349	01121
R13	Resistor, Fixed, Composition: 33 Ω, 5%, 1/4 W	5	RCR07G330JS	81349	01121
R14	Same as R10				
R15	Same as R11				
R16	Same as R12				
R17	Same as R13				
R18	Same as R10				
R19	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	1	RCR07G122JS	81349	01121
R20	Same as R12				
R21	Same as R13				
R22	Same as R13				
R23	Resistor, Fixed, Composition: 560 Ω, 5%, 1/4 W	4	RCR07G561JS	81349	01121
R24	Same as R13				
R25	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	6	RCR07G101JS	81349	01121
R26	Resistor, Variable, Film: 200 Ω, 10%, 1/2 W	3	62PR200	73138	
R27	Same as R25				
R28	Same as R26				
R29	Same as R25				
R30	Same as R26				
R31	Same as R12				
R32	Resistor, Fixed, Composition: 22 kΩ, 5%, 1/4 W	3	RCR07G223JS	81349	01121
R33	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	3	RCR07G472JS	81349	01121
R34	Same as R32				
R35	Same as R33				
R36	Same as R32				
R37	Same as R33				
R38	Same as R23				
R39	Same as R23				
R40	Same as R23				
R41	Same as R10				
R42	Resistor, Fixed, Composition: 12 Ω, 5%, 1/4 W	2	RCR07G120JS	81349	01121
R43	Same as R10				

REF DESIG PREFIX A4A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R44	Same as R42				
R45	Same as R10				
R46	Resistor, Fixed, Composition: 47 Ω, 5%, 1/4 W	1	RCR07G470JS	81349	01121
R47	Same as R12				
R48	Same as R25				
R49	Same as R25				
R50	Same as R25				
R51	Resistor, Fixed, Composition: 56 Ω, 5%, 1/4 W	1	RCR07G560JS	81349	01121
R52	Resistor, Fixed, Composition: 33 kΩ, 5%, 1/4 W	1	RCR07G333JS	81349	01121
R53	Resistor, Fixed, Composition: 6.2 kΩ, 5%, 1/4 W	1	RCR07G622JS	81349	01121
R54	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	3	RCR07G103JS	81349	01121
R55	Same as R54				
R56	Same as R54				
U1	Integrated Circuit	2	MC1458N	18324	
U2	Same as U1				

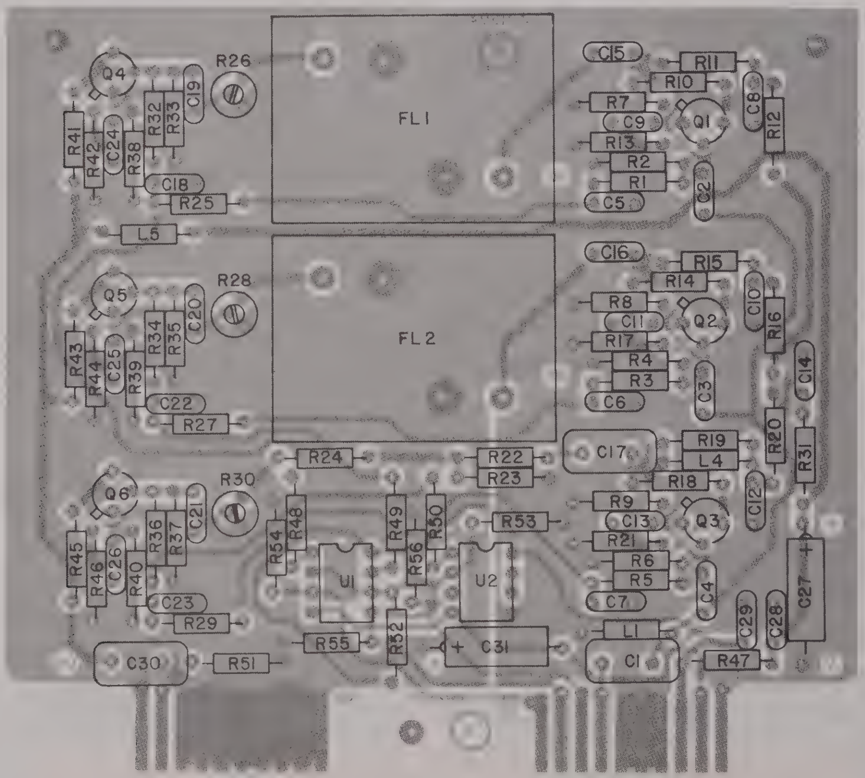


Figure 5-12A. Type 791594 10.7 MHz Filter Switch, (Product Improvement) A4A1, Location of Components

THIS PAGE LEFT BLANK

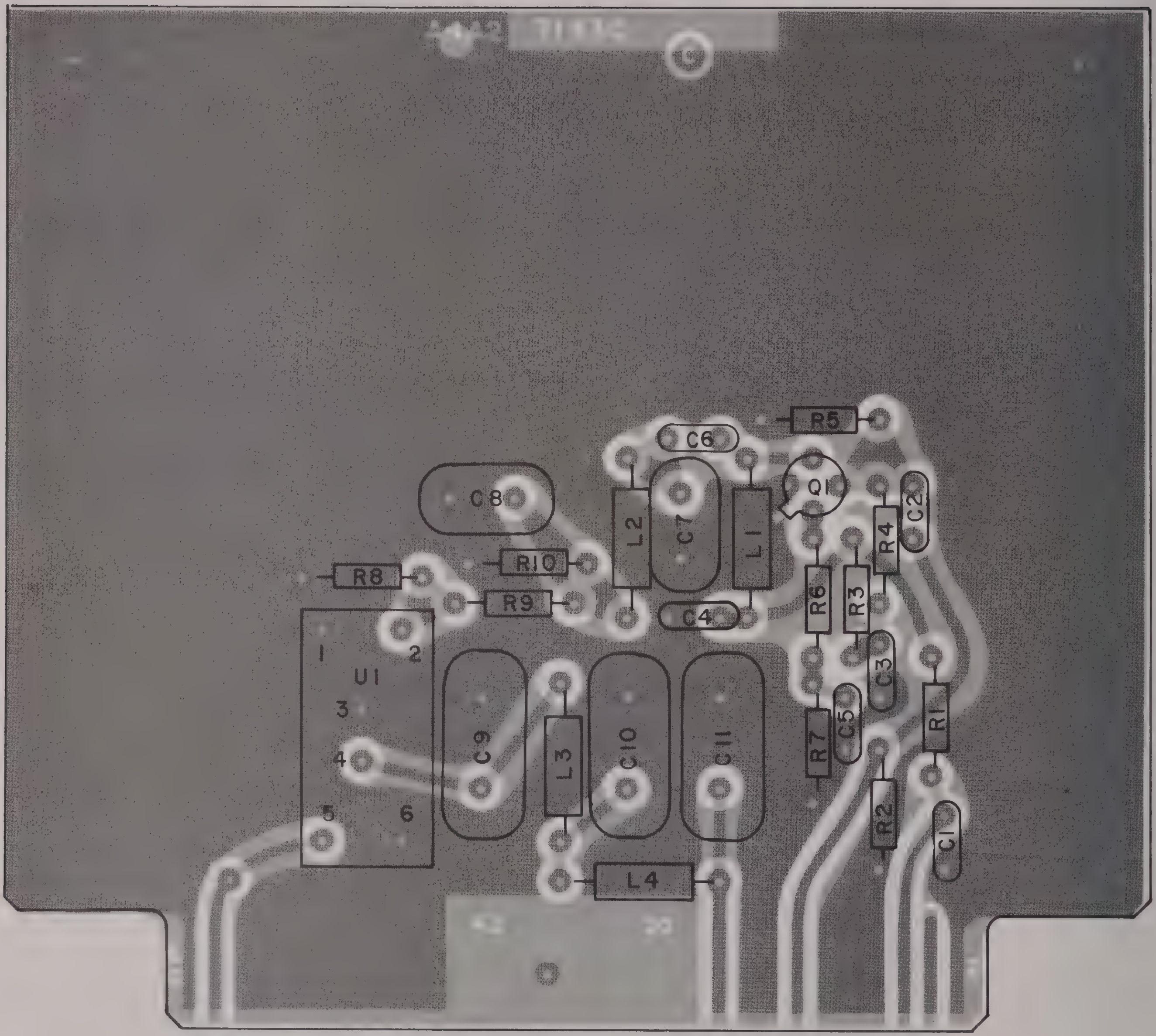


Figure 5-13. Type 71430 10.7 MHz/455 kHz Converter (A4A2), Location of Components

5.5.4.2 Type 71430 10.7 MHz/455 kHz Converter REF DESIG PREFIX A4A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	6	34453-1	14632	
C2 Thru C6	Same as C1				
C7	Capacitor, Mica, Dipped: 68 pF, 2%, 500 V	1	CM05ED680G30	81349	72136
C8	Capacitor, Mica, Dipped: 360 pF, 2%, 500 V	1	CM05FD361G03	81349	01121
C9	Capacitor, Mica, Dipped: 3900 pF, 2%, 500 V	2	CM06FD392G03	81349	01121
C10	Same as C9				
C11	Capacitor, Mica, Dipped: 1600 pF, 2%, 500 V	1	CM06FD162G03	81349	72136
L1	Coil, Fixed: 100 µH	1	1537-76	99800	
L2	Coil, Fixed: 3.3 µH	1	1537-24	99800	
L3	Coil, Fixed: 12 µH	1	1537-38	99800	
L4	Coil, Fixed: 82 µH	1	1537-72	99800	
Q1	Transistor	1	2N2708	80131	18714
R1	Resistor, Fixed, Composition: 56 Ω, 5%, 1/4 W	2	RCR07G560JS	81349	01121
R2	Same as R1				
R3	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	1	RCR07G102JS	81349	01121
R4	Resistor, Fixed, Composition: 12 kΩ, 5%, 1/4 W	1	RCR07G123JS	81349	01121
R5	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	1	RCR07G472JS	81349	01121
R6	Resistor, Fixed, Composition: 39 Ω, 5%, 1/4 W	1	RCR07G390JS	81349	01121
R7	Resistor, Fixed, Composition: 560 Ω, 5%, 1/4 W	1	RCR07G561JS	81349	01121
R8	Resistor, Fixed, Composition: 300 Ω, 5%, 1/4 W	2	RCR07G301JS	81349	01121
R9	Resistor, Fixed, Composition: 18 Ω, 5%, 1/4 W	1	RCR07G180JS	81349	01121
R10	Same as R8				
U1	Mixer, Balanced	1	GRA-3	15542	

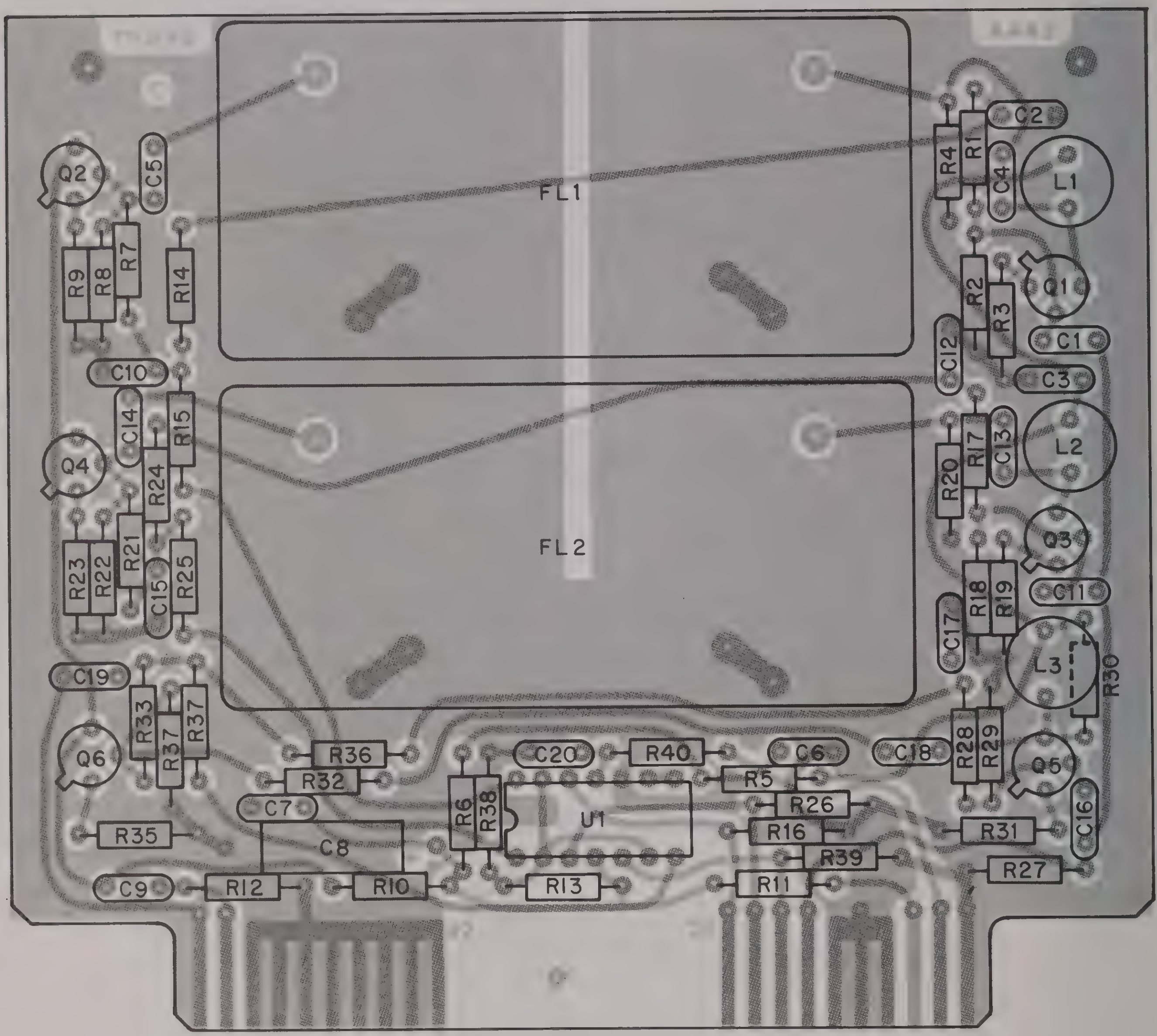


Figure 5-14. Type 791595 455 kHz Filter Switch (A4A3), Location of Components

5.5.4.3 Type 791595 455 kHz Filter Switch REF DESIG PREFIX A4A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 50 V	19	34452-1	14632	
C2 Thru C7	Same as C1				
C8	Capacitor, Electrolytic, Tantalum: 15 μF, 10%, 20 V	1	CS13BE156K	81349	01121
C9 Thru C20	Same as C1				
FL1	Filter, Bandpass: 325 Hz BW	1	92128	14632	
FL2	Filter, Bandpass: 1 kHz BW	1	92127	14632	
L1	Coil, Fixed: 6.8 mH	3	553-3635-47	71279	
L2	Same as L1				
L3	Same as L1				
Q1	Transistor	6	2N2222A	80131	04713
Q2 Thru Q6	Same as Q1				
R1	Resistor, Fixed, Composition: 22 kΩ, 5%, 1/4 W	4	RCR07G223JS	81349	01121
R2	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	3	RCR07G392JS	81349	01121
R3	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	3	RCR07G271JS	81349	01121
R4	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	3	RCR07G122JS	81349	01121
R5	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	3	RCR07G220JS	81349	01121
R6	Same as R5				
R7	Resistor, Fixed, Composition: 12 kΩ, 5%, 1/4 W	3	RCR07G123JS	81349	01121
R8	Resistor, Fixed, Composition: 1.5 kΩ, 5%, 1/4 W	3	RCR07G152JS	81349	01121
R9	Resistor, Fixed, Composition: 150 Ω, 5%, 1/4 W	3	RCR07G151JS	81349	01121
R10	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	2	RCR07G221JS	81349	01121
R11	Same as R5				
R12	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	5	RCR07G103JS	81349	01121
R13	Same as R1				
R14	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	7	RCR07G101JS	81349	01121
R15	Same as R14				
R16	Same as R12				
R17	Same as R1				
R18	Same as R2				
R19	Same as R3				
R20	Same as R4				
R21	Same as R7				
R22	Same as R8				
R23	Same as R9				
R24	Same as R14				
R25	Same as R14				
R26	Same as R12				

REF DESIG PREFIX A4A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R27	Same as R12				
R28	Same as R1				
R29	Same as R2				
R30	Same as R4				
R31	Same as R3				
R32	Same as R10				
R33	Same as R7				
R34	Same as R8				
R35	Same as R9				
R36	Same as R14				
R37	Same as R14				
R38	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	1	RCR07G472JS	81349	01121
R39	Same as R12				
R40	Same as R14				
U1	Integrated Circuit	1	MC3403P	04713	

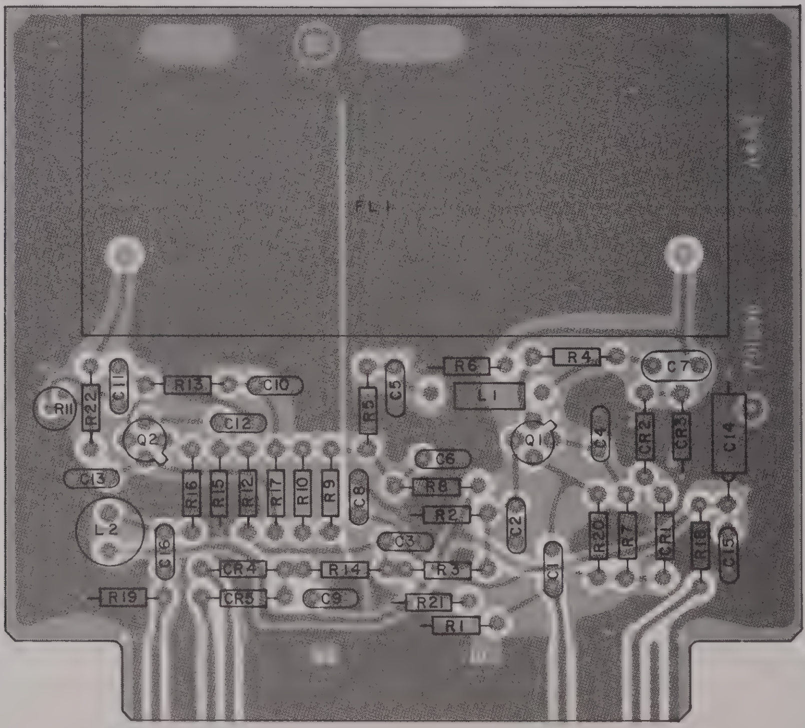


Figure 5-15. Type 791596 USB Filter Switch (A4A4), Location of Components

5.5.4.4 Type 791596 USB Filter Switch (Option)

REF DESIG PREFIX A4A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	14	34452-1	14632	
C2 Thru C6	Same as C1				
C7	Capacitor, Mica, Dipped: 270 pF, 2%, 500 V	1	CM05FD271G03	81349	72136
C8 Thru C13	Same as C1				
C14	Capacitor, Electrolytic, Tantalum: 15 µF, 10%, 20 V	1	CS13BE156K	81349	56289
C15	Same as C1				
CR1	Diode	5	1N4449	80131	93332
CR2 Thru CR5	Same as CR1				
FL1	Filter, USB	1	92122	14632	
L1	Coil, Fixed, Molded: 470 µH	1	2500-12	99800	
L2	Coil, Fixed: 6.8 mH	1	553-3635-47	71279	
Q1	Transistor (3N187)	2	841001-1	14632	
Q2	Same as Q1				
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	6	RCR07G103JS	81349	
R2	Resistor, Fixed, Composition: 470 kΩ, 5%, 1/4 W	3	RCR07G474JS	81349	01121
R3	Same as R1				
R4	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	2	RCR07G100JS	81349	01121
R5	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	3	RCR07G220JS	81349	01121
R6	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	1	RCR07G122JS	81349	01121
R7	Resistor, Fixed, Composition: 68 Ω, 5%, 1/4 W	3	RCR07G680JS	81349	01121
R8	Same as R5				
R9	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	1	RCR07G472JS	81349	01121
R10	Same as R7				
R11	Resistor, Variable, Film: 1 kΩ, 10%, 1/2 W	1	62PR1K	73138	
R12	Same as R1				
R13	Same as R2				
R14	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	1	RCR07G101JS	81349	0112
R15	Same as R2				
R16	Same as R4				
R17	Same as R7				
R18	Same as R5				
R19 Thru R21	Same as R1				
R22	Resistor, Fixed, Composition: 200 Ω, 5%, 1/4 W	1	RCR07G201JS	81349	01121

5.5.4.4A TYPE 791596 USB FILTER SWITCH REF DESIG PREFIX A4A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	11	34452-1	14632	
C2	Same as C1				
C3	Same as C1				
C4	Same as C1				
C5	Capacitor, Electrolytic, Tantalum: 15 µF, 10%, 20 V	1	CS13BE156K	81349	56289
C6	Capacitor, Mica, Dipped: 270 pF, 2%, 500 V	1	CM05FD271G03	81349	72136
C7 Thru C13	Same as C1				
CR1	Diode	2	1N4449	80131	93332
CR2	Same as CR1				
FL1	Filter, Bandpass	1	92122	14632	
L1	Coil, Fixed: 470 µH	1	2500-12	99800	
L2	Coil, Fixed: 6.8 mH	1	553-3635-47	71279	
MP1	Transipad	2	7717-44DAP	13103	
MP2	Same as MP1				
Q1	Transistor	2	2N2222A	80131	04713
Q2	Same as Q1				
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	4	RCR07G103JS	81349	01121
R2	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	2	RCR07G472JS	81349	01121
R3	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	1	RCR07G271JS	81349	01121
R4	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	2	RCR07G100JS	81349	01121
R5	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	3	RCR07G220JS	81349	01121
R6	Same as R5				
R7	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	2	RCR07G122JS	81349	01121
R8	Same as R7				
R9	Same as R4				
R10	Resistor, Fixed, Composition: 150 Ω, 5%, 1/4 W	1	RCR07G151JS	81349	01121
R11	Same as R5				
R12	Same as R1				
R13	Resistor, Fixed, Composition: 22 kΩ, 5%, 1/4 W	2	RCR07G223JS	81349	01121
R14	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	3	RCR07G101JS	81349	01121
R15	Same as R1				
R16	Same as R1				
R17	Same as R2				
R18	Resistor, Fixed, Composition: 39 kΩ, 5%, 1/4 W	1	RCR07G393JS	81349	01121
R19	Same as R14				
R20	Same as R14				
R21	Same as R13				
R22	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	1	RCR07G392JS	81349	01121
R23	Resistor, Variable, Film: 2 kΩ, 10%, 1/2 W	1	62PR2K	73138	

REF DESIG PREFIX A4A4

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R24	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
U1	Integrated Circuit	1	MC1458N	18324	

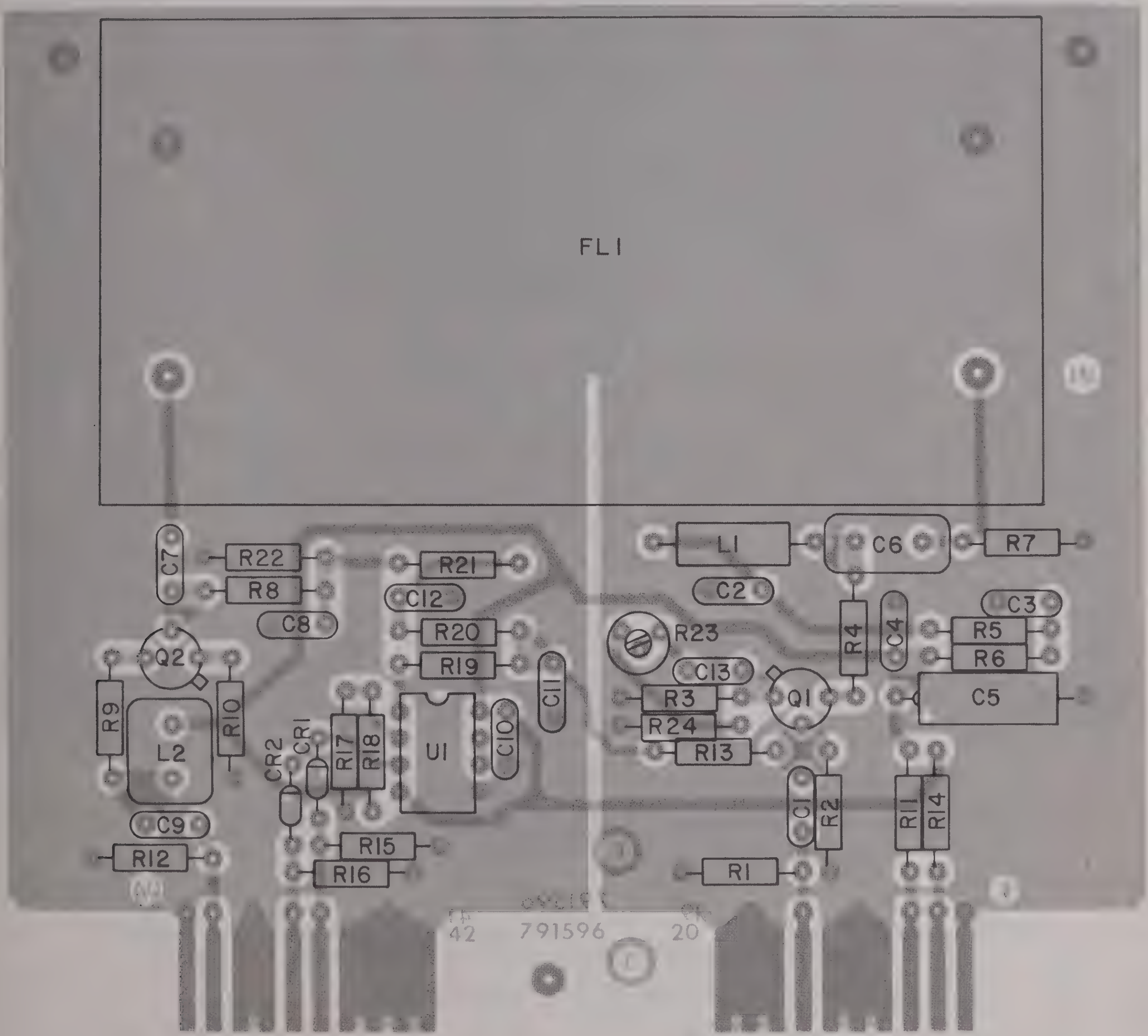


Figure 5-15A. Type 791596 USB Filter Switch (Product Improvement) A4A4, Location of Components

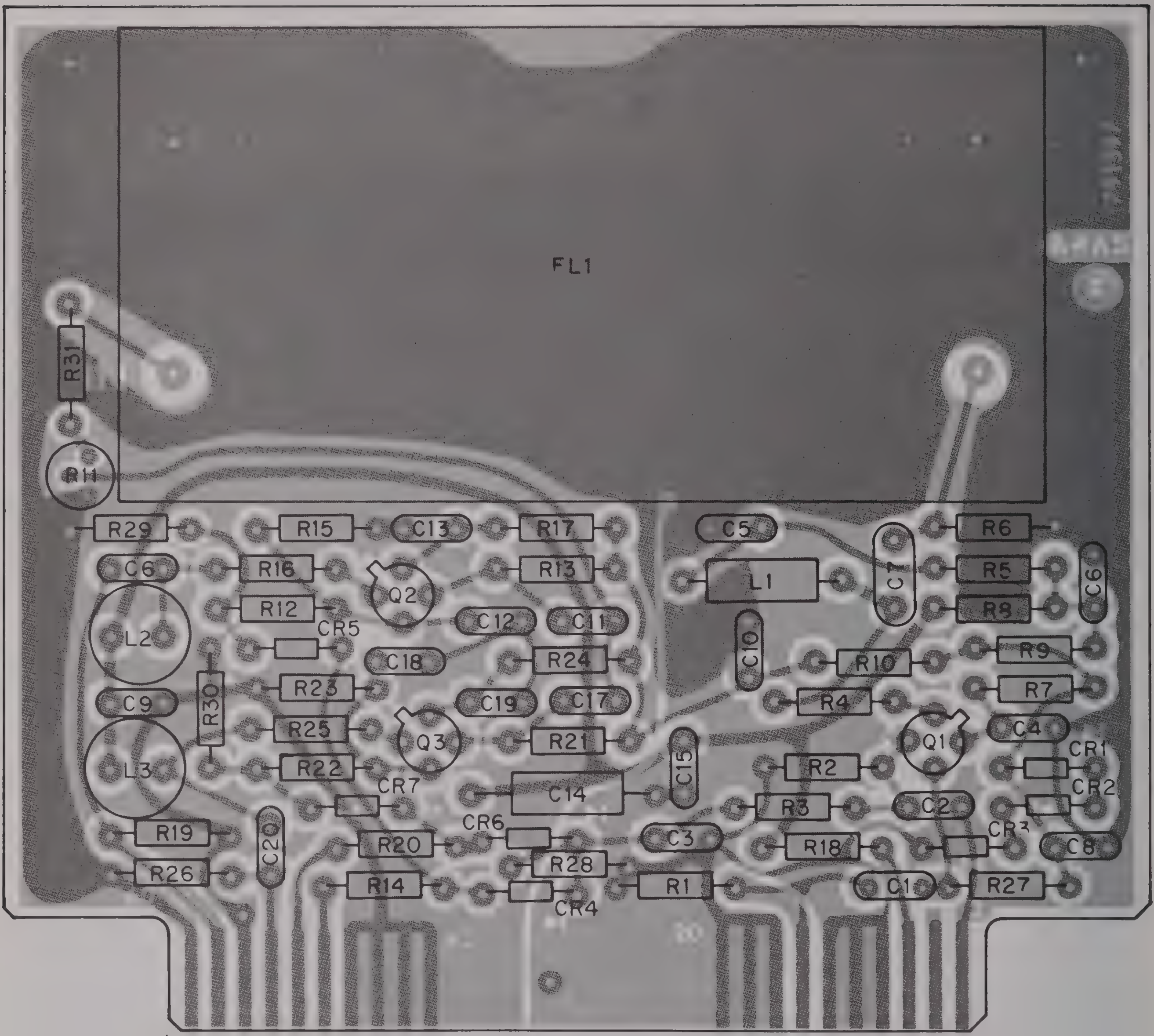


Figure 5-16. Type 791597 ISB, LSB Filter Switch (A4A5), Location of Components

5.5.4.5 Type 791597 ISB, LSB Filter Switch (Option) REF DESIG PREFIX A4A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	18	34452-1	14632	
C2 Thru C6	Same as C1				
C7	Capacitor, Mica, Dipped: 270 pF, 2%, 500 V	1	CM05FD271G03	81349	72136
C8 Thru C13	Same as C1				
C14	Capacitor, Electrolytic, Tantalum: 15 µF, 10%, 20 V	1	CS13BE156K	81349	56289
C15 Thru C20	Same as C1				
CR1	Diode	7	1N4449	80131	93332
CR2 Thru CR7	Same as CR1				
FL1	Filter, Low-Pass	1	92121	14632	
L1	Coil, Fixed, Molded: 470 µH	1	2500-12	99800	
L2	Coil, Fixed: 6.8 mH	2	553-3635-47	71279	
L3	Same as L2				
Q1	Transistor (3N187)	3	841001-1	14632	
Q2	Same as Q1				
Q3	Same as Q1				
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	10	RCR07G103JS	81349	01121
R2	Resistor, Fixed, Composition: 470 kΩ, 5%, 1/4 W	5	RCR07G474JS	81349	01121
R3	Same as R1				
R4	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	3	RCR07G100JS	81349	01121
R5	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	3	RCR07G220JS	81349	01121
R6	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	1	RCR07G122JS	81349	01121
R7	Resistor, Fixed, Composition: 68 Ω, 5%, 1/4 W	4	RCR07G680JS	81349	01121
R8	Same as R5				
R9	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	1	RCR07G472JS	81349	01121
R10	Same as R7				
R11	Resistor, Variable, Film: 1 kΩ, 10%, 1/2 W	1	62PR1K	73138	
R12	Same as R1				
R13	Same as R2				
R14	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	2	RCR07G101JS	81349	01121
R15	Same as R2				
R16	Same as R4				
R17	Same as R7				
R18	Same as R5				
R19	Same as R1				
R20	Same as R14				
R21	Same as R2				

REF DESIG PREFIX A4A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R22	Same as R1				
R23	Same as R2				
R24	Same as R7				
R25	Same as R4				
R26 Thru R30	Same as R1				
R31	Resistor, Fixed, Composition: 200 Ω, 5%, 1/4 W	1	RCR07G201JS	81349	01121

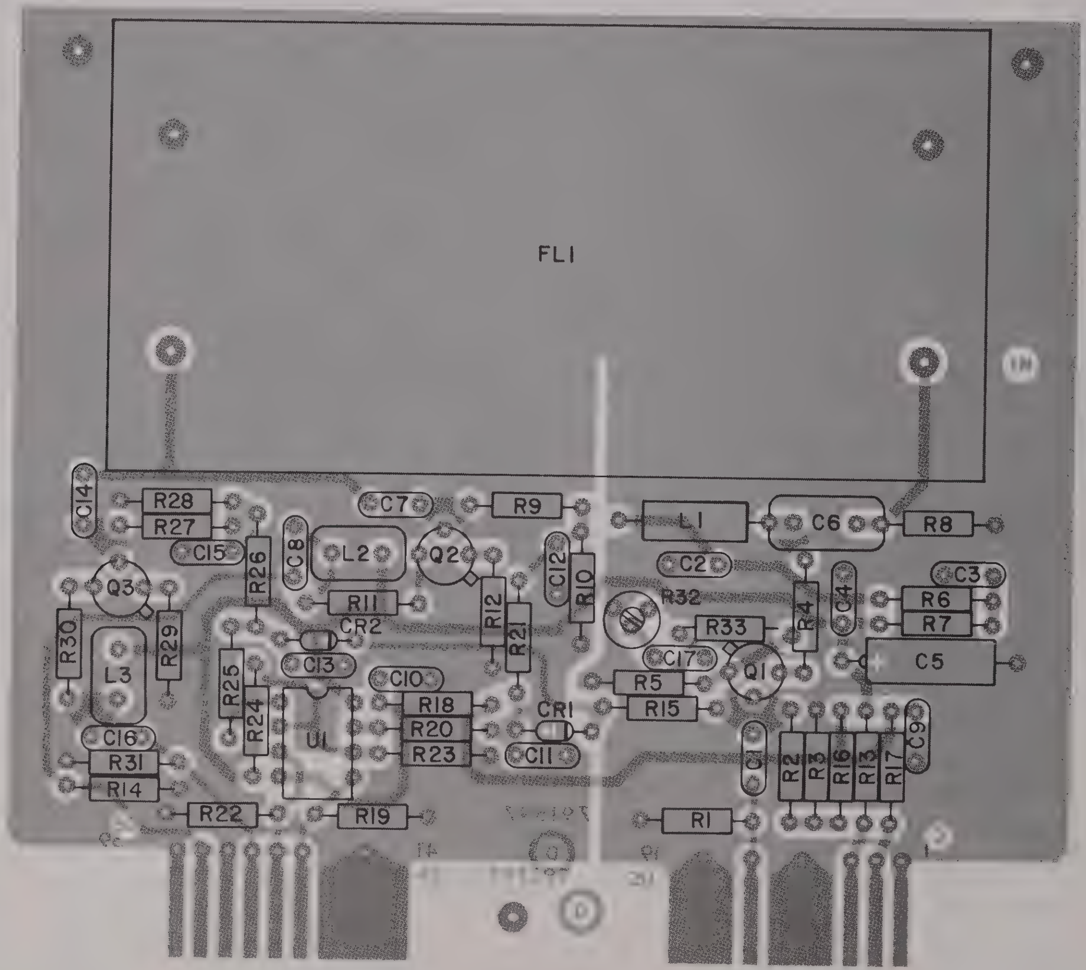


Figure 5-16A. Type 791597 ISB/LSB Filter Switch (Product Improvement) Location of Components

5.5.4.5A TYPE 791597 ISB/LSB FILTER SWITCH REF DESIG PREFIX A4A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	15	34452-1	14632	
C2	Same as C1				
C3	Same as C1				
C4	Same as C1				
C5	Capacitor, Electrolytic, Tantalum: 15 µF, 10%, 20 V	1	CS13BE156K	81349	56289
C6	Capacitor, Mica, Dipped: 270 pF, 2%, 500 V	1	CM05FD271G03	81349	72136
C7 Thru C17	Same as C1				
CR1	Diode	2	1N4449	80131	93332
CR2	Same as CR1				
FL1	Filter, Lowpass	1	92121	14632	
L1	Coil, Fixed: 470 µH	1	2500-12	99800	
L2	Coil, Fixed: 6.8 mH	2	553-3635-47	71279	
L3	Same as L2				
MP1	Transipad	3	7717-44DAP	13103	
MP2	Same as MP1				
MP3	Same as MP1				
Q1	Transistor	3	2N2222A	80131	04713
Q2	Same as Q1				
Q3	Same as Q1				
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	6	RCR07G103JS	81349	01121
R2	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	1	RCR07G392JS	81349	01121
R3	Resistor, Fixed, Composition: 1 kΩ, 5%, 1/4 W	1	RCR07G102JS	81349	01121
R4	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	3	RCR07G100JS	81349	01121
R5	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	1	RCR07G271JS	81349	01121
R6	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	4	RCR07G220JS	81349	01121
R7	Same as R6				
R8	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	1	RCR07G122JS	81349	01121
R9	Resistor, Fixed, Composition: 2.4 kΩ, 5%, 1/4 W	2	RCR07G242JS	81349	01121
R10	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	3	RCR07G472JS	81349	01121
R11	Same as R4				
R12	Resistor, Fixed, Composition: 150 Ω, 5%,1/4 W	2	RCR07G151JS	81349	01121
R13	Same as R6				
R14	Same as R1				
R15	Resistor, Fixed, Composition: 15 kΩ, 5%, 1/4 W	1	RCR07G153JS	81349	01121
R16	Same as R1				
R17	Same as R6				
R18	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	3	RCR07G101JS	81349	01121
R19	Same as R1				
R20	Same as R18				

(Product Improvement)

REF DESIG PREFIX A4A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R21	Resistor, Fixed, Composition: 22 kΩ, 5%, 1/4 W	2	RCR07G223JS	81349	01121
R22	Same as R1				
R23	Same as R10				
R24	Resistor, Fixed, Composition: 24 kΩ, 5%, 1/4 W	1	RCR07G243JS	81349	01121
R25	Same as R18				
R26	Same as R21				
R27	Same as R9				
R28	Same as R10				
R29	Same as R12				
R30	Same as R4				
R31	Same as R1				
R32	Resistor, Variable, Film: 2 kΩ, 10%, 1/2 W	1	62PR2K	73138	
R33	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
U1	Integrated Circuit	1	MC1458N	18324	

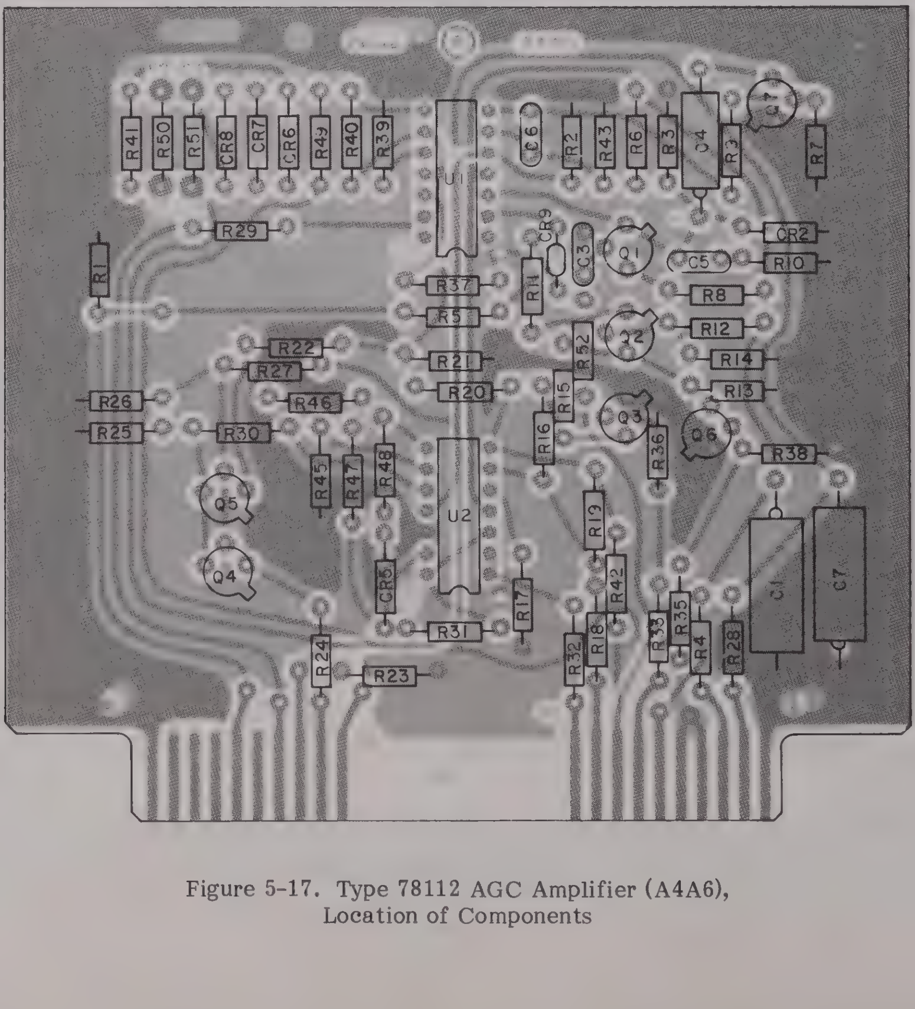


Figure 5-17. Type 78112 AGC Amplifier (A4A6),
Location of Components

5.5.4.6 Type 78112 AGC Amplifier REF DESIG PREFIX A4A6

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Electrolytic, Tantalum: 47 µF, 10%, 20 V	2	CS13BE476K	81349	56289
C2	Not Used				
C3	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	2	34452-1	14632	
C4	Capacitor, Electrolytic, Tantalum: 33 µF, 10%, 10 V	1	CS13BC336K	81349	56289
C5	Same as C3				
C6	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V	1	34475-1	14632	
C7	Same as C1				
CR1	Not Used				
CR2	Diode, Zener: 5.6 V	1	1N752A	80131	04713
CR3	Not Used				
CR4	Not Used				
CR5	Diode	5	1N4449	80131	93332
CR6 Thru CR9	Same as CR5				
Q1	Transistor	6	2N2222A	80131	04713
Q2	Transistor	1	2N2907/JAN	81350	04713
Q3 Thru Q7	Same as Q1				
R1	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	4	RCR07G104JS	81349	01121
R2	Resistor, Fixed, Composition: 47 kΩ, 5%, 1/4 W	4	RCR07G473JS	81349	01121
R3	Resistor, Fixed, Composition: 470 kΩ, 5%, 1/4 W	2	RCR07G474JS	81349	01121
R4	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	5	RCR07G101JS	81349	01121
R5	Same as R1				
R6	Resistor, Fixed, Composition: 330 kΩ, 5%, 1/4 W	1	RCR07G334JS	81349	01121
R7	Resistor, Fixed, Composition: 6.8 kΩ, 5%, 1/4 W	4	RCR07G682JS	81349	01121
R8	Same as R4				
R9	Resistor, Fixed, Composition: 15 kΩ, 5%, 1/4 W	4	RCR07G153JS	81349	01121
R10	Resistor, Fixed, Composition: 150 kΩ, 5%, 1/4 W	1	RCR07G154JS	81349	01121
R11	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	7	RCR07G103JS	81349	01121
R12	Resistor, Fixed, Composition: 82 kΩ, 5%, 1/4 W	1	RCR07G823JS	81349	01121
R13	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	2	RCR07G102JS	81349	01121
R14	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	1	RCR07G122JS	81349	01121
R15	Same as R7				
R16	Same as R7				
R17	Resistor, Fixed, Composition: 22 kΩ, 5%, 1/4 W	1	RCR07G223JS	81349	01121
R18	Resistor, Fixed, Composition: 270 kΩ, 5%, 1/4 W	1	RCR07G274JS	81349	01121
R19	Resistor, Fixed, Composition: 680 kΩ, 5%, 1/4 W	1	RCR07G684JS	81349	01121
R20	Same as R11				
R21	Same as R9				
R22	Same as R9				

REF DESIG PREFIX A4A6

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R23	Same as R3				
R24	Same as R9				
R25	Resistor, Fixed, Composition: 1.5 kΩ, 5%, 1/4 W	1	RCR07G152JS	81349	01121
R26	Resistor, Fixed, Composition: 2.2 kΩ, 5%, 1/4 W	1	RCR07G222JS	81349	01121
R27	Same as R11				
R28	Same as R4				
R29	Same as R4				
R30	Same as R11				
R31	Resistor, Fixed, Composition: 2.7 kΩ, 5%, 1/4 W	1	RCR07G272JS	81349	01121
R32	Resistor, Fixed, Composition: 390 Ω, 5%, 1/4 W	2	RCR07G391JS	81349	01121
R33	Same as R11				
R34	Not Used				
R35	Same as R11				
R36	Resistor, Fixed, Composition: 68 kΩ, 5%, 1/4 W	3	RCR07G683JS	81349	01121
R37	Same as R1				
R38	Same as R36				
R39	Same as R36				
R40	Same as R1				
R41	Same as R7				
R42	Same as R4				
R43	Same as R2				
R44	Not Used				
R45	Same as R11				
R46*	Resistor, Fixed, Composition: 39 kΩ, 5%, 1/4 W	1	RCR07G393JS	81349	01121
R47	Resistor, Fixed, Composition: 820 Ω, 5%, 1/4 W	1	RCR07G821JS	81349	01121
R48	Resistor, Fixed, Composition: 68 Ω, 5%, 1/4 W	1	RCR07G680JS	81349	01121
R49	Resistor, Fixed, Composition: 3.3 kΩ, 5%, 1/4 W	1	RCR07G332JS	81349	01121
R50*	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	1	RCR07G392JS	81349	01121
R51*	Same as R32				
R52	Same as R13				
U1	Integrated Circuit	2	MC3403P	04713	
U2	Same as U1				
	* Nominal value, final value factory selected.				

5.5.4.7 Type 72488 455 kHz Amplifier/AM Detector

REF DESIG PREFIX A4A7

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 50 V	20	34452-1	14632	
C2	Same as C1				
C3	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 50 V	3	34453-1	14632	
C4	Not Used				
C5	Same as C1				
C6	Same as C1				
C7	Same as C3				
C8	Same as C1				
C9	Capacitor, Mica, Dipped: 3300 pF, 2%, 500 V	2	CM06FD332G03	81349	72136
C10	Capacitor, Mica, Dipped: 180 pF, 2%, 500 V	2	CM05FD181G03	81349	72136
C11	Same as C9				
C12 Thru C20	Same as C1				
C21	Not Used				
C22 Thru C25	Same as C1				
C26	Same as C10				
C27	Same as C1				
C28	Same as C3				
C29	Capacitor, Electrolytic, Tantalum: 15 μF, 10%, 20 V	1	CS13BE156K	81349	56289
C30	Same as C1				
CR1	Diode	5	1N4449	80131	93332
CR2 Thru CR5	Same as CR1				
L1	Coil, Fixed: 6.8 mH	5	553-3635-47	71279	
L2	Coil, Variable: 39 μH	2	558-7107-32	71279	
L3	Same as L2				
L4 Thru L7	Same as L1				
Q1	Transistor (3N187)	2	841001-1	14632	
Q2	Same as Q1				
Q3	Transistor	4	2N2222A	80131	04713
Q4 Thru Q6	Same as Q3				
R1	Resistor, Fixed, Composition: 33 kΩ, 5%, 1/4 W	1	RCR07G333JS	81349	01121
R2	Resistor, Fixed, Composition: 2.2 kΩ, 5%, 1/4 W	2	RCR07G222JS	81349	01121
R3	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	2	RCR07G392JS	81349	01121
R4	Resistor, Fixed, Composition: 39 kΩ, 5%, 1/4 W	2	RCR07G393JS	81349	01121
R5	Resistor, Fixed, Composition: 120 kΩ, 5%, 1/4 W	2	RCR07G124JS	81349	01121
R6	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	2	RCR07G271JS	81349	01121

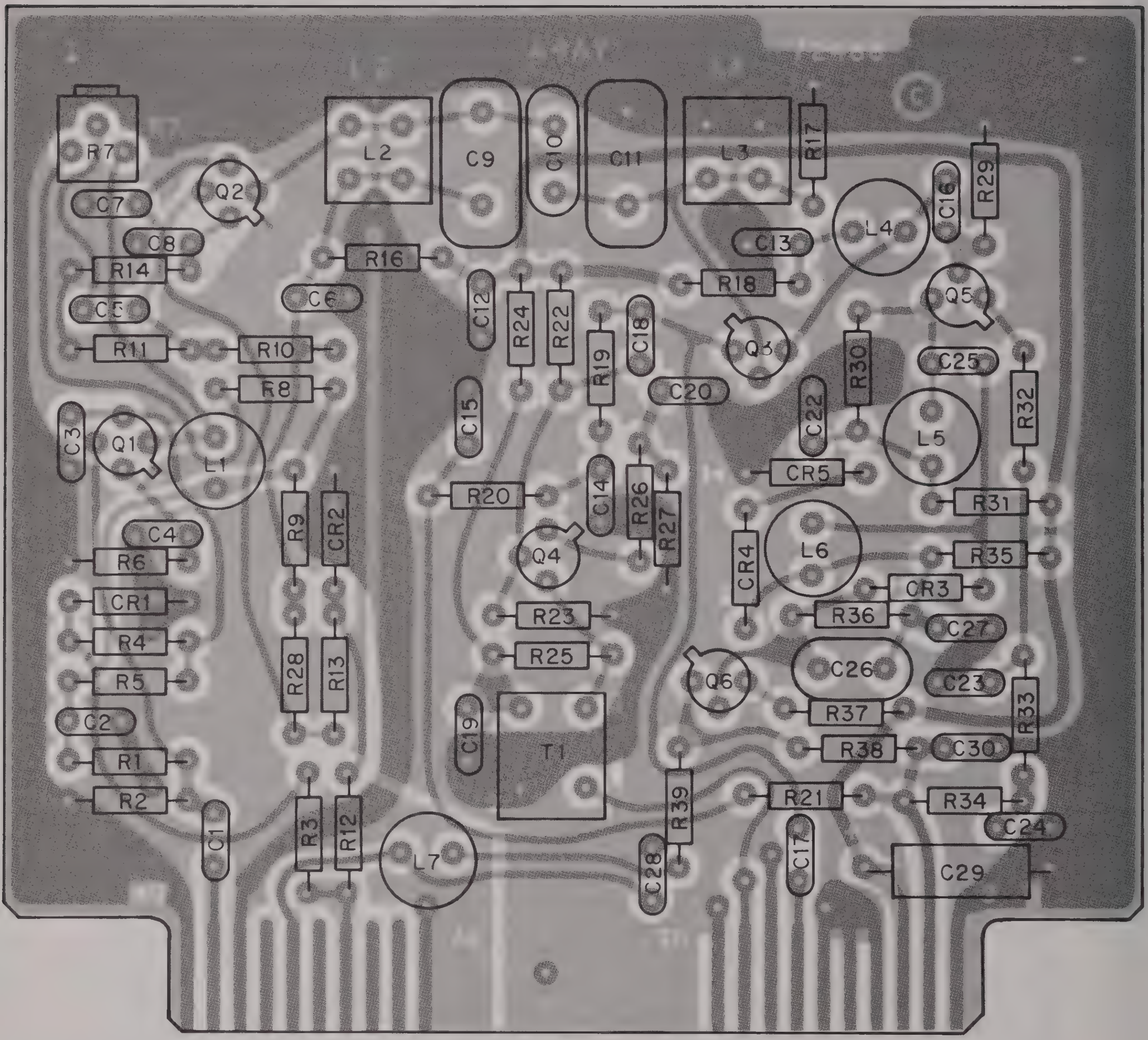


Figure 5-18. Type 72488 455 kHz Amplifier/AM Detector (A4A7), Location of Components

REF DESIG PREFIX A4A7

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R7	Resistor, Variable, Film: 5 kΩ, 10%, 1/2 W	1	62PAR5K	73138	
R8	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	2	RCR07G221JS	81349	01121
R9	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	6	RCR07G101JS	81349	01121
R10	Resistor, Fixed, Composition: 680 kΩ, 5%, 1/4 W	1	RCR07G684JS	81349	01121
R11	Resistor, Fixed, Composition: 47 kΩ, 5%, 1/4 W	2	RCR07G473JS	81349	01121
R12	Same as R3				
R13	Same as R4				
R14	Same as R6				
R15	Not Used				
R16	Resistor, Fixed, Composition: 47 Ω, 5%, 1/4 W	2	RCR07G470JS	81349	01121
R17	Resistor, Fixed, Composition: 8.2 kΩ, 5%, 1/4 W	1	RCR07G822JS	81349	01121
R18	Same as R9				
R19	Same as R9				
R20	Resistor, Fixed, Composition: 3.3 kΩ, 5%, 1/4 W	1	RCR07G332JS	81349	01121
R21	Same as R9				
R22	Resistor, Fixed, Composition: 12 kΩ, 5%, 1/4 W	1	RCR07G123JS	81349	01121
R23	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	1	RCR07G472JS	81349	01121
R24	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	1	RCR07G220JS	81349	01121
R25	Resistor, Fixed, Composition: 470 Ω, 5%, 1/4 W	1	RCR07G471JS	81349	01121
R26	Resistor, Fixed, Composition: 15 Ω, 5%, 1/4 W	1	RCR07G150JS	81349	01121
R27	Resistor, Fixed, Composition: 150 Ω, 5%, 1/4 W	1	RCR07G151JS	81349	01121
R28	Same as R5				
R29	Resistor, Fixed, Composition: 1.5 kΩ, 5%, 1/4 W	1	RCR07G152JS	81349	01121
R30	Same as R2				
R31	Same as R9				
R32	Same as R8				
R33	Resistor, Fixed, Composition: 1.8 kΩ, 5%, 1/4 W	1	RCR07G812JS	81349	01121
R34	Same as R9				
R35	Resistor, Fixed, Composition: 5.6 kΩ, 5%, 1/4 W	1	RCR07G562JS	81349	01121
R36	Same as R11				
R37	Same as R16				
R38	Resistor, Fixed, Composition: 6.8 kΩ, 5%, 1/4 W	1	RCR07G682JS	81349	01121
R39	Resistor, Fixed, Composition: 560 Ω, 5%, 1/4 W	1	RCR07G561JS	81349	01121
T1	Transformer, Wide-Band	1	70-130	06978	

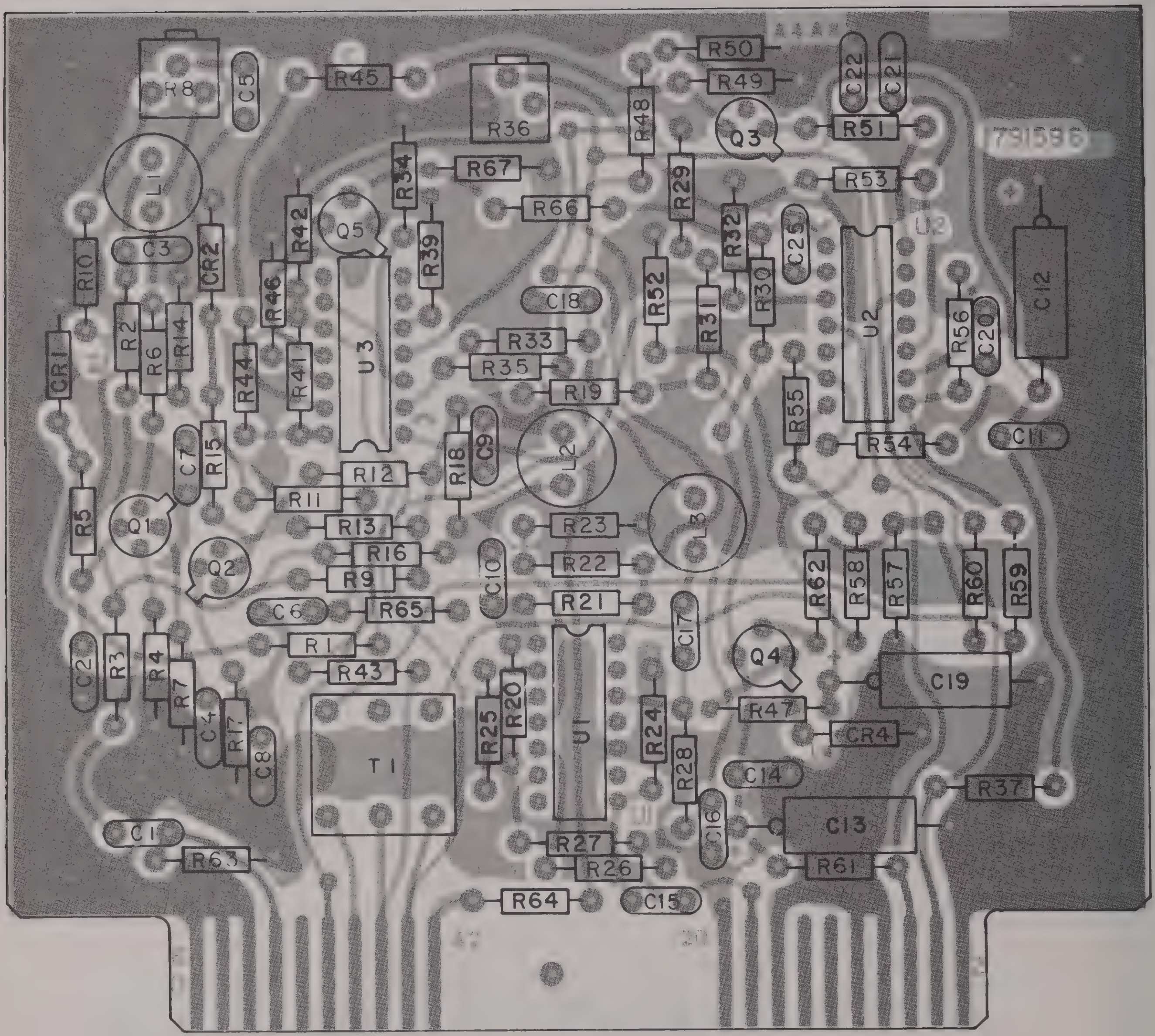


Figure 5-19. Type 791598 ISB Detector/Audio (A4A8), Location of Components

5.5.4.8 Type 791598 ISB Detector/Audio

REF DESIG PREFIX A4A8

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	18	34452-1	14632	
C2	Same as C1				
C3	Same as C1				
C4	Not Used				
C5 Thru C11	Same as C1				
C12	Capacitor, Electrolytic, Tantalum: 15 µF, 10%, 20 V	2	CS13BE156K	81349	56289
C13	Same as C12				
C14 Thru C17	Same as C1				
C18	Capacitor, Ceramic, Disc: 3300 pF, 10%, 200 V	1	CK06BX332K	81349	56289
C19	Capacitor, Electrolytic, Tantalum: 4.7 µF, 10%, 35 V	1	CS13BF475K	81349	56289
C20	Same as C1				
C21	Same as C1				
C22	Same as C1				
C23	Not Used				
C24	Not Used				
C25	Same as C1				
CR1	Diode	3	1N4449	80131	93332
CR2	Same as CR1				
CR3	Not Used				
CR4	Same as CR1				
L1	Coil, Fixed: 6.8 mH	2	553-3635-47	71279	
L2	Same as L1				
L3	Coil, Fixed: 47 mH	1	553-3635-57	71279	
Q1	Transistor	2	841001-1	14632	
Q2	Same as Q1				
Q3	Transistor	2	2N2907/JAN	81350	04713
Q4	Transistor	1	2N2222A	80131	04713
Q5	Same as Q3				
R1	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	4	RCR07G392JS	81349	01121
R2	Resistor, Fixed, Composition: 120 kΩ, 5%, 1/4 W	2	RCR07G124JS	81349	01121
R3	Resistor, Fixed, Composition: 33 kΩ, 5%, 1/4 W	2	RCR07G333JS	81349	01121
R4	Resistor, Fixed, Composition: 2.2 kΩ, 5%, 1/4 W	3	RCR07G222JS	81349	01121
R5	Resistor, Fixed, Composition: 39 kΩ, 5%, 1/4 W	2	RCR07G393JS	81349	01121
R6	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	2	RCR07G100JS	81349	01121
R7	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	5	RCR07G271JS	81349	01121
R8	Resistor, Variable, Film: 5 kΩ, 10%, 1/2 W	1	62PAR5K	73138	
R9	Resistor, Fixed, Composition: 47 Ω, 5%, 1/4 W	1	RCR07G470JS	81349	01121
R10	Same as R7				
R11	Same as R1				

REF DESIG PREFIX A4A8

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R12	Same as R2				
R13	Resistor, Fixed, Composition: 680 kΩ, 5%, 1/4 W	2	RCR07G684JS	81349	01121
R14	Resistor, Fixed, Composition: 47 kΩ, 5%, 1/4 W	4	RCR07G473JS	81349	01121
R15	Same as R5				
R16	Same as R6				
R17	Same as R7				
R18	Same as R4				
R19	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	3	RCR07G220JS	81349	01121
R20	Resistor, Fixed, Composition: 6.8 kΩ, 5%, 1/4 W	2	RCR07G682JS	81349	01121
R21	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	6	RCR07G103JS	81349	01121
R22	Same as R21				
R23	Same as R20				
R24	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	4	RCR07G102JS	81349	01121
R25	Same as R24				
R26	Resistor, Fixed, Composition: 15 kΩ, 5%, 1/4 W	3	RCR07G153JS	81349	01121
R27	Same as R1				
R28	Same as R1				
R29	Same as R14				
R30	Same as R4				
R31	Resistor, Fixed, Composition: 330 kΩ, 5%, 1/4 W	1	RCR07G334JS	81349	01121
R32	Same as R14				
R33	Resistor, Fixed, Composition: 12 kΩ, 5%, 1/4 W	1	RCR07G123JS	81349	01121
R34	Resistor, Fixed, Composition: 1.0 MΩ, 5%, 1/4 W	2	RCR07G105JS	81349	01121
R35	Same as R34				
R36	Resistor, Variable, Film: 25 kΩ, 10%, 1/2 W	1	62PAR25K	73138	
R37	Same as R19				
R38	Not Used				
R39	Same as R14				
R40	Not Used				
R41	Same as R21				
R42	Same as R26				
R43	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	2	RCR07G101JS	81349	01121
R44	Same as R13				
R45	Same as R26				
R46	Resistor, Fixed, Composition: 22 kΩ, 5%, 1/4 W	3	RCR07G223JS	81349	01121
R47	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	2	RCR07G472JS	81349	01121
R48	Resistor, Fixed, Composition: 82 kΩ, 5%, 1/4 W	1	RCR07G823JS	81349	01121
R49	Same as R24				
R50	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	1	RCR07G122JS	81349	01121
R51	Same as R21				
R52	Resistor, Fixed, Composition: 3.3 MΩ, 5%, 1/4 W	1	RCR07G335JS	81349	01121

REF DESIG PREFIX A4A8

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R53	Same as R3				
R54	Resistor, Fixed, Film: 18.2 kΩ, 1%, 1/10 W	1	RN55C1822F	81349	75042
R55	Resistor, Fixed, Film: 82.5 kΩ, 1%, 1/10 W	1	RN55C8252F	81349	75042
R56	Resistor, Fixed, Film: 100 kΩ, 1%, 1/10 W	1	RN55C1003F	81349	75042
R57	Same as R21				
R58	Same as R7				
R59	Same as R7				
R60	Same as R21				
R61	Same as R19				
R62	Same as R24				
R63	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
R64	Same as R46				
R65	Same as R43				
R66	Resistor, Fixed, Composition: 68 kΩ, 5%, 1/4 W	1	RCR07G683JS	81349	01121
R67	Same as R46				
R68	Same as R47				
T1	Transformer	1	LL010	07388	
U1	Integrated Circuit	1	MC1496P	04713	
U2	Integrated Circuit	2	MC3403P	04713	
U3	Same as U2				

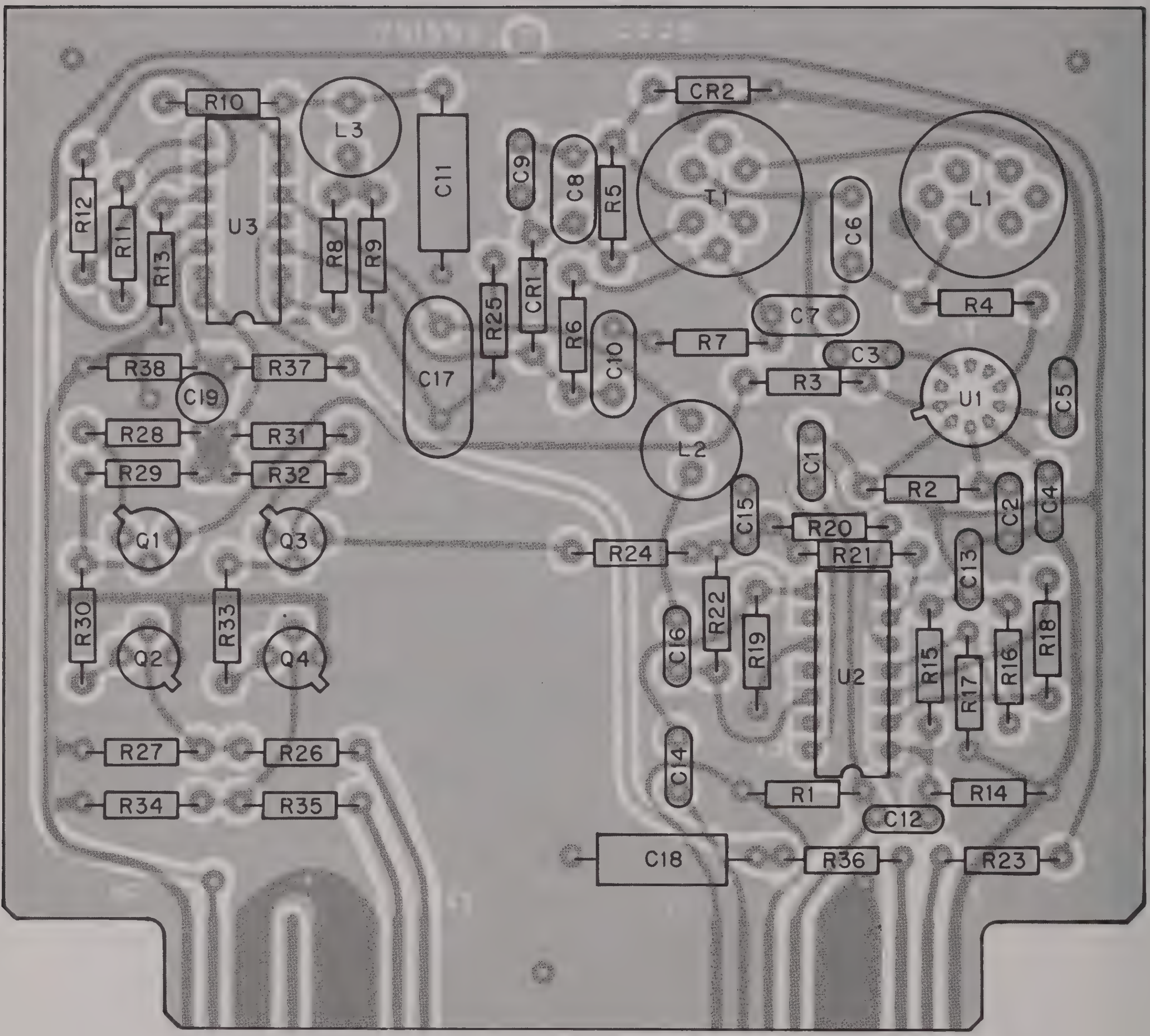


Figure 5-20. Type 791599 FM, CW, and SSB Detector (A4A9), Location of Components

5.5.4.9 Type 791599 FM, CW, & SSB Detector REF DESIG PREFIX A4A9

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 60 V	10	34452-1	14632	
C2 Thru C5	Same as C1				
C6	Capacitor, Mica, Dipped: 470 pF, 2%, 500 V	1	DM15-471G	72136	
C7	Capacitor, Mica, Dipped: 330 pF, 2%, 500 V	2	CM05FD331G03	81349	72136
C8	Capacitor, Mica, Dipped: 390 pF, 2%, 500 V	1	CM05FD391G03	81349	72136
C9	Capacitor, Ceramic, Disc: 150 pF, 5%, 50 V	1	1U150RJ	93958	
C10	Same as C7				
C11	Capacitor, Plastic, Tubular: 0.015 µF, 5%, 100 V	1	663UW153-5-1W	84411	
C12 Thru C16	Same as C1				
C17	Capacitor, Mica, Dipped: 3300 pF, 2%, 500 V	1	CM06FD332G03	81349	72136
C18	Capacitor, Electrolytic, Tantalum: 15 µF, 10%, 20 V	1	CS13BE156K	81349	72136
C19	Capacitor, Electrolytic, Tantalum: 4.7 µF, 20%, 35 V	1	196D475X0035JE3	56289	
CR1	Diode	2	1N4449	80131	93332
CR2	Same as CR1				
L1	Coil, Variable	1	30312-258	14632	
L2	Coil, Fixed: 47 mH	2	553-3635-57	71279	
L3	Same as L2				
Q1	Transistor	2	2N2907/JAN	81350	04713
Q2	Transistor	2	2N2222A	80131	04713
Q3	Same as Q1				
Q4	Same as Q2				
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	4	RCR07G103JS	81349	01121
R2	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	3	RCR07G102JS	81349	01121
R3	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
R4	Resistor, Fixed, Composition: 47 Ω, 5%, 1/4 W	3	RCR07G470JS	81349	01121
R5	Resistor, Fixed, Composition: 68 kΩ, 5%, 1/4 W	3	RCR07G683JS	81349	01121
R6	Resistor, Fixed, Composition: 47 kΩ, 5%, 1/4 W	3	RCR07G473JS	81349	01121
R7	Resistor, Fixed, Composition: 56 kΩ, 5%, 1/4 W	1	RCR07G563JS	81349	01121
R8	Resistor, Fixed, Composition: 4.7 kΩ, 5%, 1/4 W	2	RCR07G472JS	81349	01121
R9	Resistor, Fixed, Composition: 2.2 kΩ, 5%, 1/4 W	1	RCR07G222JS	81349	01121
R10	Resistor, Fixed, Composition: 560 kΩ, 5%, 1/4 W	1	RCR07G564JS	81349	01121
R11	Resistor, Fixed, Composition: 470 kΩ, 5%, 1/4 W	1	RCR07G474JS	81349	01121
R12	Resistor, Fixed, Composition: 15 kΩ, 5%, 1/4 W	3	RCR07G153JS	81349	01121
R13	Same as R12				
R14	Resistor, Fixed, Composition: 6.8 kΩ, 5%, 1/4 W	4	RCR07G682JS	81349	01121
R15	Same as R1				
R16	Same as R1				
R17	Same as R14				
R18	Same as R2				

REF DESIG PREFIX A4A9

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R19	Same as R2				
R20	Same as R12				
R21	Resistor, Fixed, Composition: 3.9 kΩ, 5%, 1/4 W	2	RCR07G392JS	81349	01121
R22	Same as R21				
R23	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	2	RCR07G101JS	81349	01121
R24	Resistor, Fixed, Composition: 150 Ω, 5%, 1/4 W	1	RCR07G151JS	81349	01121
R25	Resistor, Fixed, Composition: 5.6 kΩ, 5%, 1/4 W	1	RCR07G562JS	81349	01121
R26	Same as R5				
R27	Same as R6				
R28	Same as R4				
R29	Resistor, Fixed, Composition: 82 kΩ, 5%, 1/4 W	2	RCR07G823JS	81349	01121
R30	Same as R14				
R31	Same as R4				
R32	Same as R29				
R33	Same as R14				
R34	Same as R6				
R35	Same as R5				
R36	Same as R23				
R37	Same as R8				
R38	Same as R1				
T1	Transformer	1	30312-257	14632	
U1	Integrated Circuit	1	CA3012	02735	
U2	Integrated Circuit	1	MC1496P	04713	
U3	Integrated Circuit	1	MC3403P	04713	

5.5.4.10 Type 7459 Audio Amplifier

REF DESIG PREFIX A4A10

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	6	34452-1	14632	
C2	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V	2	33475-1	14632	
C3	Same as C1				
C4	Capacitor, Electrolytic, Tantalum: 4.7 µF, 10%, 35 V	2	CS13BE475K	81349	56289
C5	Not Used				
C6	Same as C1				
C7	Same as C1				
C8	Same as C2				
C9	Same as C1				
C10	Same as C4				
C11	Not Used				
C12	Capacitor, Electrolytic, Tantalum: 15 µF, 10%, 20 V	2	CS13BE156K	81349	56289
C13	Same as C12				
C14	Same as C1				
C15	Not Used				
C16	Not Used				
C17	Capacitor, Ceramic, Disc: 5000 pF, 20%, 500 V	1	SM5000PFM	91418	
C18	Capacitor, Electrolytic, Tantalum: 47 µF, 10%, 35 V	3	CS13BE476K	81349	56289
C19	Same as C18				
C20	Same as C18				
C21	Capacitor, Mica, Dipped: 24 pF, 5%, 500 V	1	CM05ED240J03	81349	72136
CR1	Diode	1	1N4449	80131	93332
CR2	Diode	2	1N198A	80131	93332
CR3	Same as CR2				
CR4	Diode	1	1N4003	80131	04713
Q1	Transistor	1	U1899E	15818	
Q2	Transistor	1	TIP 29	01295	
R1	Resistor, Fixed, Composition: 22 kΩ, 5%, 1/4 W	3	RCR07G223JS	81349	01121
R2	Resistor, Fixed, Composition: 330 kΩ, 5%, 1/4 W	2	RCR07G334JS	81349	01121
R3	Resistor, Fixed, Composition: 47 kΩ, 5%, 1/4 W	2	RCR07G473JS	81349	01121
R4	Same as R3				
R5	Resistor, Fixed, Composition: 2.2 MΩ, 5%, 1/4 W	1	RCR07G225JS	81349	01121
R6	Resistor, Fixed, Film: 2.0 kΩ, 1%, 1/10 W	2	RN55C2001F	81349	01121
R7	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	3	RCR07G104JS	81349	01121
R8	Same as R7				
R9	Resistor, Fixed, Film: 100 kΩ, 1%, 1/10 W	4	RN55C1003F	81349	75042
R10	Same as R9				
R11	Same as R1				
R12	Resistor, Fixed, Composition: 12 kΩ, 5%, 1/4 W	1	RCR07G123JS	81349	01121
R13	Resistor, Fixed, Composition: 27 kΩ, 5%, 1/4 W	1	RCR07G273JS	81349	01121
R14	Resistor, Fixed, Composition: 6.8 kΩ, 5%, 1/4 W	2	RCR07G682JS	81349	01121

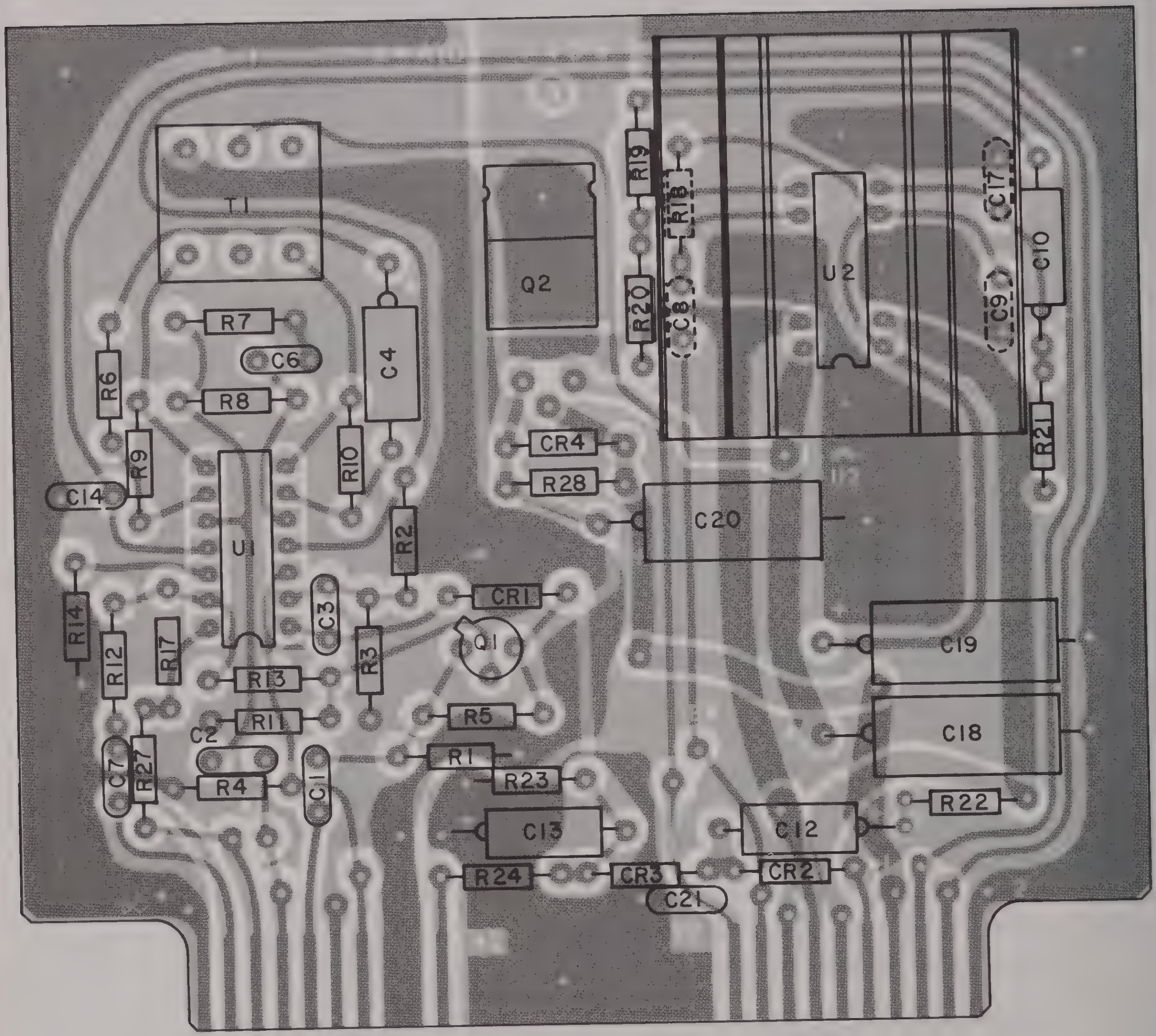


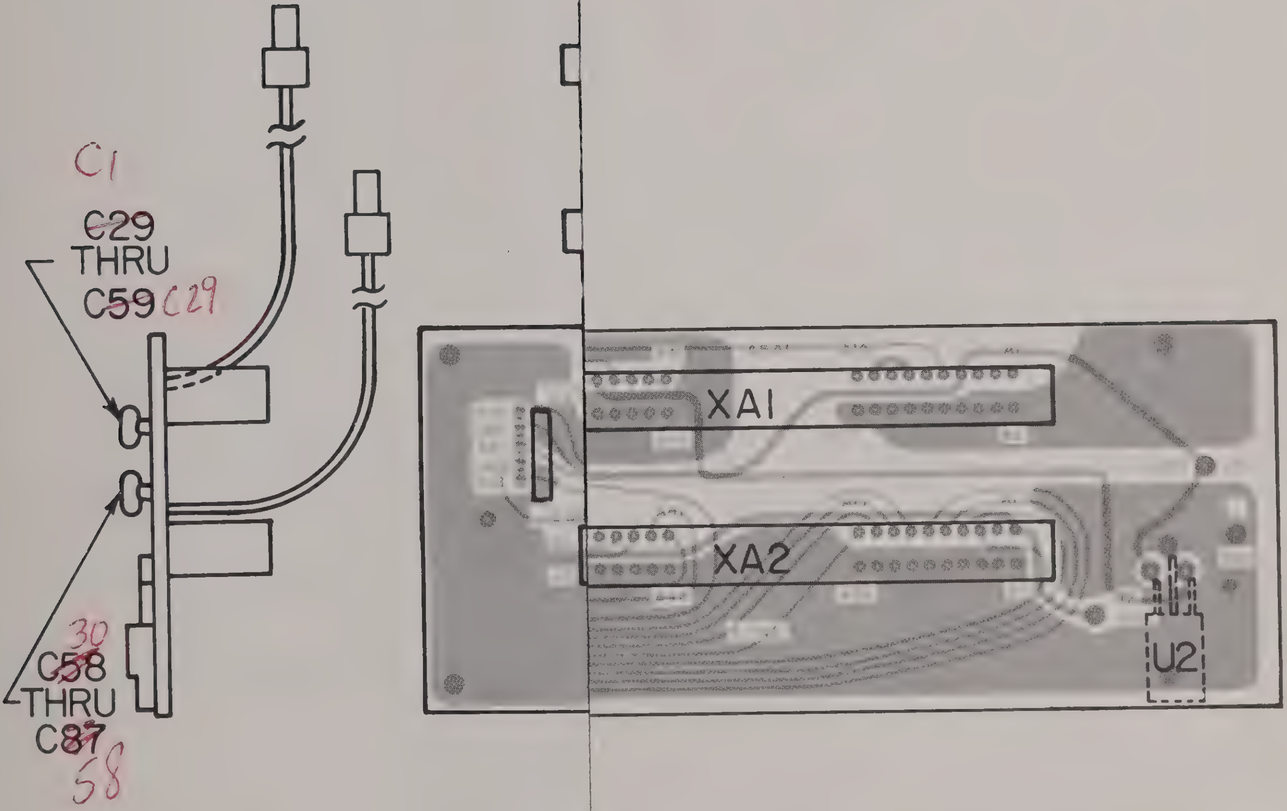
Figure 5-21. Type 7459 Audio Amplifier (A4A10), Location of Components

REF DESIG PREFIX A4A10

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R15	Not Used				
R16	Not Used				
R17	Resistor, Fixed, Composition: 18 kΩ, 5%, 1/4 W	1	RCR07G183JS	81349	01121
R18	Same as R7				
R19	Same as R6				
R20	Same as R9				
R21	Same as R9				
R22	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	2	RCR07G101JS	81349	01121
R23	Same as R1				
R24	Same as R14				
R25	Not Used				
R26	Not Used				
R27	Same as R22				
R28	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
RA1	Heatsink	1	24566-1	14632	
T1	Transformer	1	LL010	07388	
U1	Integrated Circuit	1	MC3403P	04713	
U2	Integrated Circuit	1	LM378N	27014	

5.5.5 TYPE 791570 SYNTHESIZER MOTHERBOARD REF DESIG PREFIX A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	1st & 3rd LO, Timebase	1	791630	14632	
A2	2nd LO Synthesizer	1	791601	14632	
A3	BFO Synthesizer	1	791576	14632	
C1	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 50 V	58	34453-1	14632	
C2 Thru C58	Same as C1				
C59	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 50 V	4	34452	14632	
C60	Same as C59				
C61	Same as C59				
C62	Same as C59				
J1	Faston, Tabs	3	62073-1	00779	
J2	Same as J1				
J3	Same as J1				
L1	Ferrite, Choke	4	VK200-10-3B	02114	
L2 Thru L4	Same as L1				
MP1	Housing, P.C. Connector	5	117798-3	00779	
MP2 Thru MP5	Same as MP1				
MP6	Insulator, Mica	2	B05608A001	04713	
MP7	Same as MP6				
- -	Cable Assembly	1	34832-1	14632	
P1	Plug Assembly	1	88523-1	00779	
- -	Cable Assembly	1	34832-2	14632	
P2	Plug Assembly	1	88524-1	00779	
U1, U2	INTEGRATED CIRCUITS		7805UC	07263	



5-22. Type 791570 Synthesizer Motherboard (A5), Location of Components

5.5.5 TYPE 791570 SYNTHESIZER MOTHERBOARD REF DESIG PREFIX A5

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	1st & 3rd LO, Timebase	1	791630	14632	
A2	2nd LO Synthesizer	1	791601	14632	
A3	BFO Synthesizer	1	791576	14632	
C1	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 50 V	58	34453-1	14632	
C2 Thru C58	Same as C1				
C59	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 50 V	4	34452	14632	
C60	Same as C59				
C61	Same as C59				
C62	Same as C59				
J1	Faston, Tabs	3	62073-1	00779	
J2	Same as J1				
J3	Same as J1				
L1	Ferrite, Choke	4	VK200-10-3B	02114	
L2 Thru L4	Same as L1				
MP1	Housing, P.C. Connector	5	117798-3	00779	
MP2 Thru MP5	Same as MP1				
MP6	Insulator, Mica	2	B05608A001	04713	
MP7	Same as MP6				
- -	Cable Assembly	1	34832-1	14632	
P1	Plug Assembly	1	88523-1	00779	
- -	Cable Assembly	1	34832-2	14632	
P2	Plug Assembly	1	88524-1	00779	
U1, U2	INTEGRATED CIRCUITS		7805UC	07263	

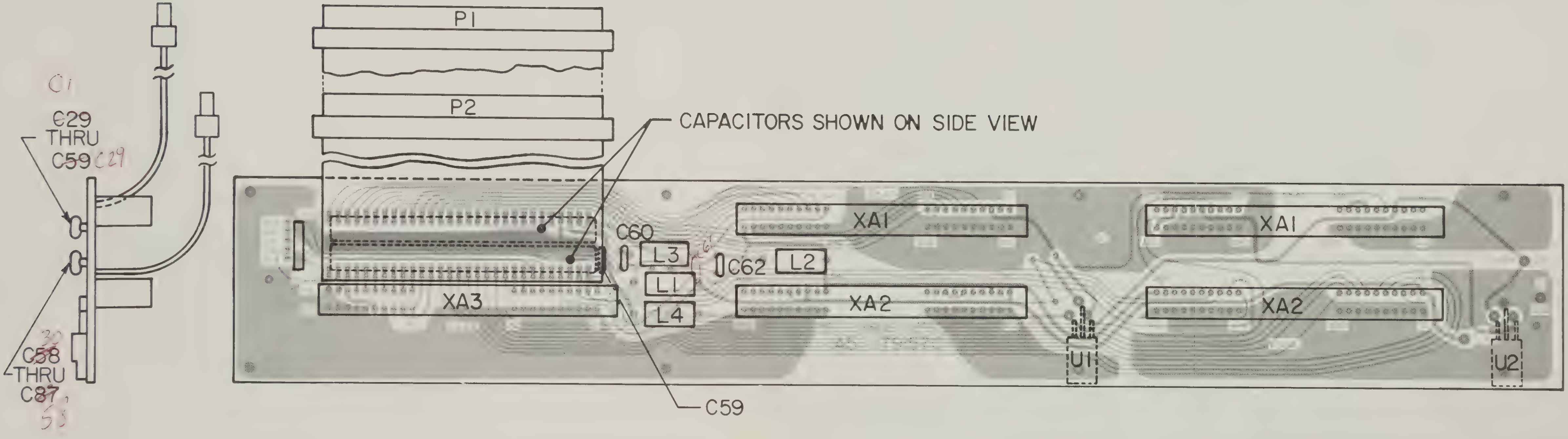
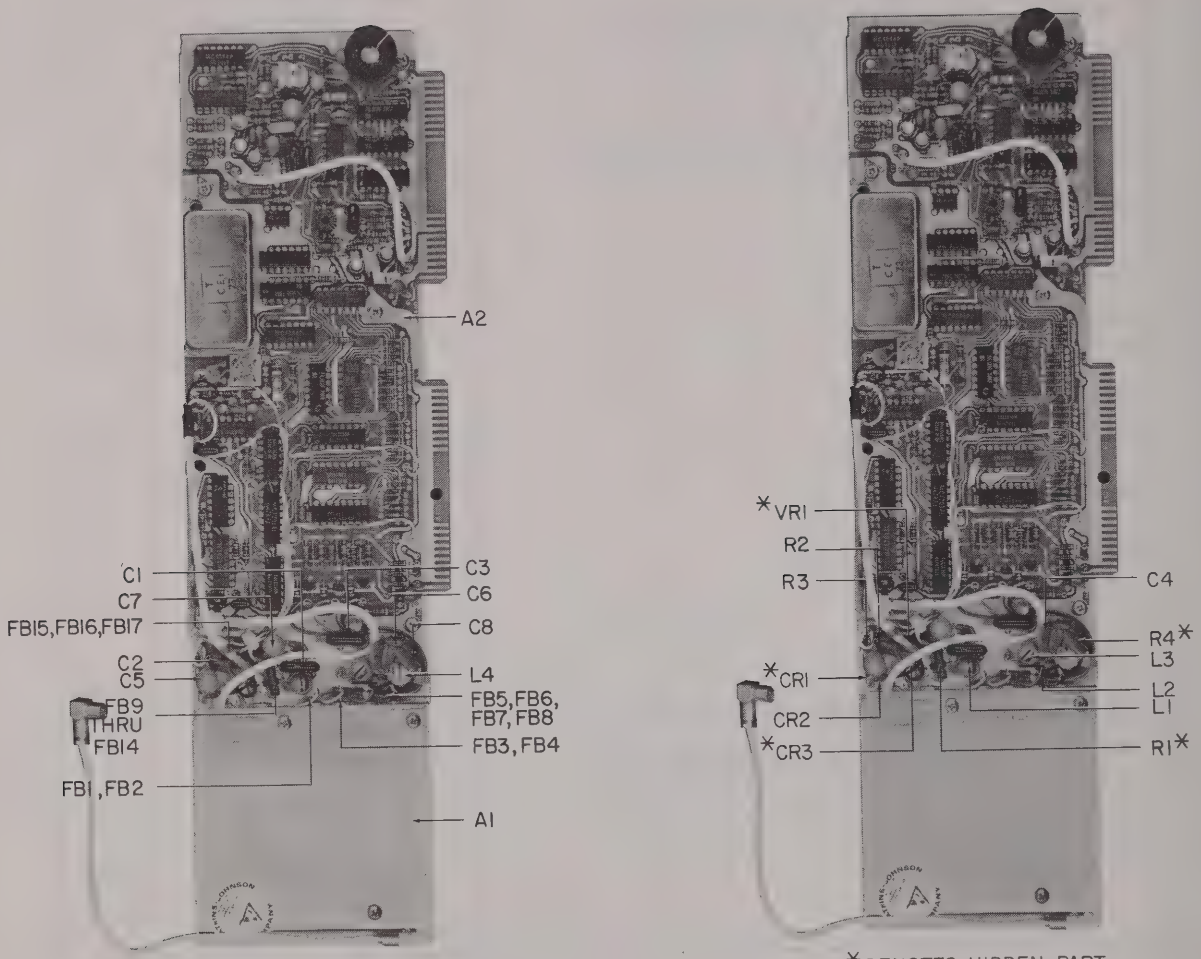


Figure 5-22. Type 791570 Synthesizer Motherboard (A5), Location of Components

5.5.5.1 Type 791630 1st and 3rd LO Synthesizer/Timebase REF DESIG PREFIX A5A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	1st LO VCO Assembly	1	791629	14632	
A2	1st & 3rd LO Synthesizer	1	791600	14632	
C1	Capacitor, Mica, Dipped: 1600 pF, 2%, 500 V	2	CM06FD162G03	81349	72136
C2	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 100 V	2	8131M100-651-474M	72982	
C3	Same as C1				
C4	Capacitor, Ceramic, Disc: 0.05 μF, 20%, 100 V	2	C023B101R503M	56289	
C5	Capacitor, Electrolytic, Tantalum: 47 μF, 20%, 20 V	2	196D476X0020PE4	56289	
C6	Same as C2				
C7	Same as C5				
C8	Same as C4				
CR1	Diode	3	1N4449	80131	93332
CR2	Same as CR1				
CR3	Same as CR1				
FB1	Ferrite Bead	17	56-590-65-4A	02114	
FB2 Thru FB17	Same as FB1				
L1	Coil, Fixed: 10 mH	2	553-3635-49	71279	
L2	Coil, Fixed: 0.82 μH	1	1537-10	99800	
L3	Same as L1				
L4	Coil, Fixed: 4.7 mH	1	553-3635-45	71279	
R1	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	1	RCR07G101JS	81349	01121
R2	Resistor, Fixed, Composition: 6.2 kΩ, 5%, 1/4 W	1	RCR07G622JS	81349	01121
R3	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	2	RCR07G102JS	81349	01121
R4	Same as R3				
VR1	Voltage Regulator: 12 V	1	MC7912CP	04713	



*DENOTES HIDDEN PART

Figure 5-23. Type 791630 1st and 3rd LO Synthesizer/Timebase (A5A1), Location of Components

5.5.5.1.1 Type 791629 1st LO VCO Assembly REF DESIG PREFIX A5A1A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	1st LO Voltage Controlled Oscillator	1	34750	14632	
C1	Capacitor, Ceramic, Feedthru: 1000 pF, GMV, 500 V	5	54-794-009-102W	33095	
C2 Thru C4	Same as C1				
C5	Capacitor, Electrolytic, Tantalum: 68 μF, 20%, 15 V	1	183DR686X0015F	56289	
C6	Same as C1				
E1	Connector, Termination	1	144/188	19505	
P1	Connector, Plug: SMC Series	1	UG1465/U	80058	19505
P2	Connector, Plug: SMC Series	1	UG1466/U	80058	19505
R1	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/8 W	3	RCR05G122JS	81349	01121
R2	Same as R1				
R3	Same as R1				
R4	Resistor, Fixed, Composition: 47 Ω, 5%, 1/8 W	1	RCR05G470JS	81349	01121

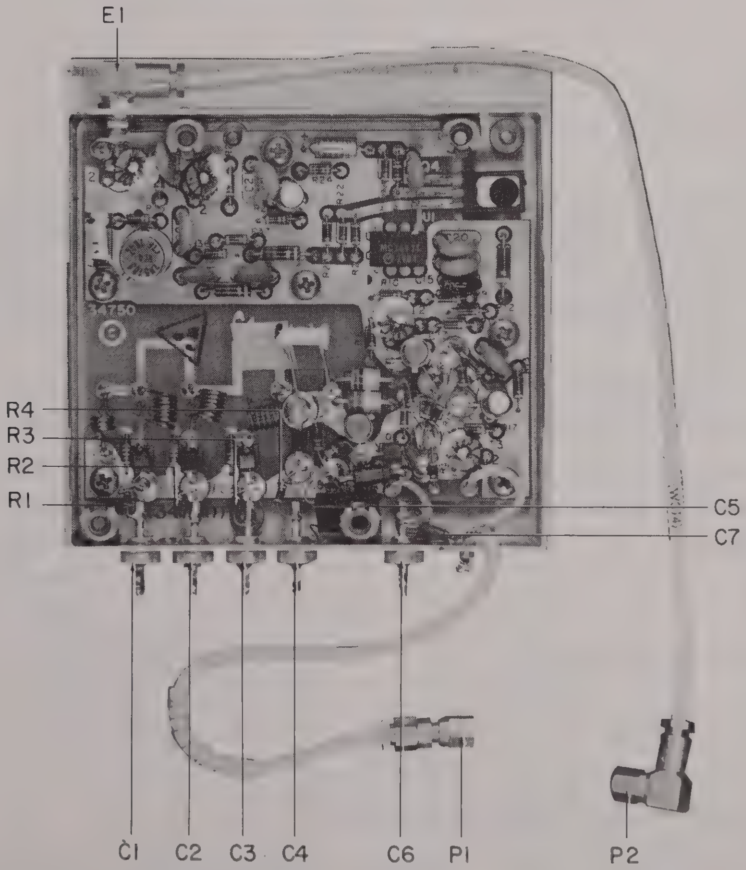


Figure 5-24. Type 791629 1st LO VCO Assembly (A5A1A1), Location of Components

5.5.5.1.1.1 Part 34750 1st LO Voltage Controlled Oscillator REF DESIG PREFIX A5A1A1A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Chip: 200 pF, 50%, 500 V	10	32-257578-40	91984	
C2 Thru C4	Same as C1				
C5	Capacitor, Ceramic, Chip: 3 pF, ±0.25 pF, 500 V	1	603C0G3R0C	91984	
C6*	Capacitor, Ceramic, Tubular: 4.3 pF, ±0.25 pF, 500 V	1	301-000C0H0-439C	72982	
C7	Capacitor, Composition, Tubular: 2.7 pF, 10%, 500 V	1	QC2.7PFK	95121	
C8	Same as C1				
C9	Capacitor, Composition, Tubular: 1.0 pF, 10%, 500 V	1	QC1.0PFK	95121	
C10	Same as C1				
C11	Capacitor, Ceramic, Disc: 0.1 μF, 20%, 50 V	1	34475-1	14632	
C12	Same as C1				
C13	Same as C1				
C14	Capacitor, Ceramic, Disc: 470 pF, 20%, 1000 V	7	B470PFM	91418	
C15	Capacitor, Mica, Dipped: 100 pF, 2%, 500 V	1	CM04FD101G03	81349	72136
C16	Same as C1				
C17	Same as C1				
C18	Capacitor, Electrolytic, Tantalum: 2.2 μF, 10%, 20 V	1	CS13BE225K	81349	56289
C19	Same as C14				
C20	Same as C14				
C21	Same as C14				
C22	Not Used				
C23	Same as C14				
C24	Not Used				
C25	Same as C14				
C26	Capacitor, Ceramic, Disc: 5000 pF, 20%, 100 V	2	C023B101E502M	56289	
C27	Same as C26				
C28	Capacitor, Ceramic, Tubular: 5.1 pF, ±0.5 pF, 500 V	1	301-000C0H0-519D	72982	
C29	Same as C14				
CR1	Diode, PIN Switching	3	MPN3401	04713	
CR2	Same as CR1				
CR3	Same as CR1				
CR4	Diode, Varicap	1	BB105B	25088	
FB1	Ferrite Bead	1	56-590-65-4A	02114	
L1	Coil, Air	1	24592-1	14632	
L2	Coil, Air	2	24593-1	14632	
L3	Same as L2				
L4	Coil, Air	1	24593-2	14632	
L5	Coil, Fixed: 0.56 μH	1	202-11	99848	
	* Nominal value, final value factory selected.				

REF DESIG PREFIX A5A1A1A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
Q1	Transistor	1	U310	17856	
Q2	Transistor	2	2N2857	80131	02735
Q3	Same as Q2				
Q4	Transistor	1	2N4918	80131	04713
Q5	Transistor	1	2N3251	80131	04713
Q6	Not Used				
Q7	Transistor	1	2N5109	80131	02735
R1	Resistor, Fixed, Composition: 33 kΩ, 5%, 1/8 W	2	RCR05G333JS	81349	01121
R2	Resistor, Fixed, Composition: 12 kΩ, 5%, 1/8 W	1	RCR05G123JS	81349	01121
R3	Resistor, Fixed, Composition: 22 kΩ, 5%, 1/8 W	1	RCR05G223JS	81349	01121
R4	Resistor, Fixed, Composition: 470 Ω, 5%, 1/8 W	4	RCR05G471JS	81349	01121
R5	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/8 W	1	RCR05G104JS	81349	01121
R6	Resistor, Fixed, Composition: 8.2 kΩ, 5%, 1/8 W	2	RCR05G822JS	81349	01121
R7	Resistor, Fixed, Composition: 5.6 kΩ, 5%, 1/8 W	2	RCR05G562JS	81349	01121
R8	Resistor, Fixed, Composition: 300 Ω, 5%, 1/8 W	2	RCR05G301JS	81349	01121
R9	Resistor, Fixed, Composition: 220 Ω, 5%, 1/8 W	1	RCR05G221JS	81349	01121
R10	Resistor, Fixed, Composition: 68 Ω, 5%, 1/8 W	2	RCR05G680JS	81349	01121
R11	Resistor, Fixed, Composition: 180 Ω, 5%, 1/8 W	1	RCR05G181JS	81349	01121
R12	Same as R10				
R13	Same as R6				
R14	Same as R7				
R15	Resistor, Fixed, Composition: 47 Ω, 5%, 1/8 W	4	RCR05G470JS	81349	01121
R16	Same as R8				
R17	Resistor, Fixed, Composition: 150 Ω, 5%, 1/8 W	1	RCR05G151JS	81349	01121
R18	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/8 W	2	RCR05G102JS	81349	01121
R19	Resistor, Fixed, Composition: 390 Ω, 5%, 1/8 W	1	RCR05G391JS	81349	01121
R20	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	1	RCR07G100JS	81349	01121
R21	Same as R4				
R22	Same as R4				
R23	Resistor, Fixed, Composition: 10 Ω, 5%, 1/8 W	1	RCR05G100JS	81349	01121
R24	Resistor, Fixed, Composition: 33 Ω, 5%, 1/8 W	1	RCR05G330JS	81349	01121
R25	Resistor, Fixed, Composition: 270 Ω, 5%, 1/8 W	1	RCR05G271JS	81349	01121
R26	Same as R15				
R27	Same as R1				
R28	Same as R15				
R29	Resistor, Fixed, Compostion: 22 Ω, 5%, 1/4 W	1	RCR07G220JS	81349	01121
R30	Same as R15				
R31	Not Used				
R32	Not Used				
R33	Not Used				
R34	Resistor, Fixed, Composition: 15 Ω, 5%, 1/8 W	1	RCR05G150JS	81349	01121

REF DESIG PREFIX A5A1A1A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R35	Resistor, Fixed, Composition: 560 Ω, 5%, 1/8 W	1	RCR05G561JS	81349	01121
R36	Same as R18				
R37	Same as R4				
R38	Not Used				
R39	Not Used				
R40	Resistor, Fixed, Composition: 51 Ω, 5%, 1/4 W	1	RCR07G510JS	81349	01121
T1	Part of PC Board				
T2	Transformer, Toroidal	2	21278-23	14632	
T3	Same as T2				
T4	Transformer, Toroidal	2	21278-27	14632	
T5	Not Used				
T6	Same as T4				
U1	Integrated Circuit	1	MC1697P	04713	

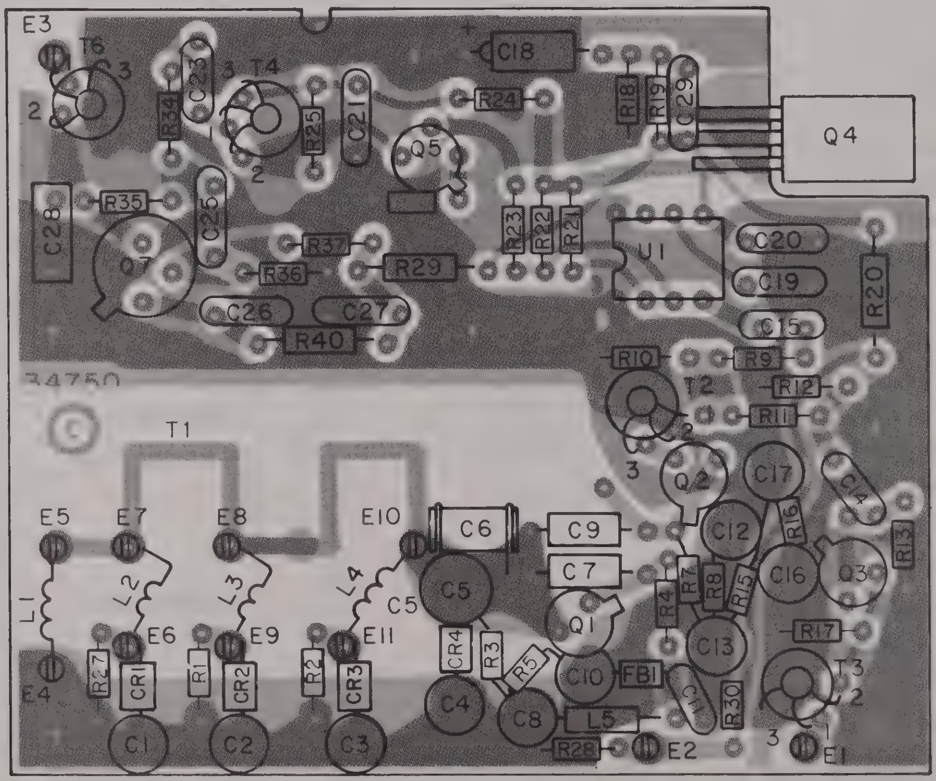


Figure 5-25. Part 34750 1st LO Voltage Controlled Oscillator (A5A1A1A1) Location of Components

5.5.5.1.2 Type 791600 1st & 3rd LO Synthesizer REF DESIG PREFIX A5A1A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Mica, Dipped: 47 pF, 2%, 500 V	2	CM04ED470G03	81349	72136
C2	Same as C1				
C3	Capacitor, Ceramic, Disc: 470 pF, 20%, 1000 V	2	B470PFM	91418	
C4	Not Used				
C5	Not Used				
C6	Not Used				
C7	Capacitor, Ceramic, Disc: 0.01 μF, 20%, 1000 V	13	34453-1	14632	
C8 Thru C15	Same as C7				
C16	Capacitor, Electrolytic, Tantalum: 22 μF, 20%, 15 V	7	196D226X0015KE3	56289	
C17	Same as C3				
C18	Capacitor, Fixed, Plastic: 4700 pF, 10%, 100 V	1	WMF1D47	14655	
C19	Not Used				
C20	Capacitor, Ceramic, Disc: 0.1 μF, 20%, 100 V	2	8131M100-651-104M	72982	
C21	Same as C7				
C22	Capacitor, Ceramic, Disc: 1000 pF, GMV, 500 V	1	SM1000PFP	91418	
C23	Capacitor, Mica, Dipped: 820 pF, 5%, 300 V	1	DM15-821J	72136	
C24	Not Used				
C25	Same as C16				
C26	Same as C16				
C27	Not Used				
C28	Capacitor, Ceramic, Tubular: 47 pF, 5%, 500 V	1	308-000C0G0-470J	72982	
C29	Capacitor, Electrolytic, Tantalum: 100 μF, 20%, 10 V	1	196D107X0010LA3	56289	
C30	Capacitor, Electrolytic, Tantalum: 2.2 μF, 20%, 35 V	1	196D225X0035JE3	56289	
C31	Same as C16				
C32	Same as C20				
C33	Capacitor, Variable, Ceramic: 2-8 pF, 350 V	1	538-006A2-8	72982	
C34	Capacitor, Mica, Dipped: 220 pF, 2%, 500 V	2	CM05FD221G03	81349	72136
C35	Same as C34				
C36	Same as C7				
C37	Same as C7				
C38	Same as C16				
C39	Same as C16				
C40	Not Used				
C41	Same as C7				
C42	Same as C16				
C43	Capacitor, Mica, Dipped: 18 pF, 5%, 500 V	1	CM04CD180J03	81349	72136
C44	Capacitor, Mica, Dipped: 330 pF, 2%, 500 V	1	CM05FD331G03	81349	72136
CR1	Diode	3	5082-2800	28480	
CR2	Same as CR1				
CR3	Same as CR1				

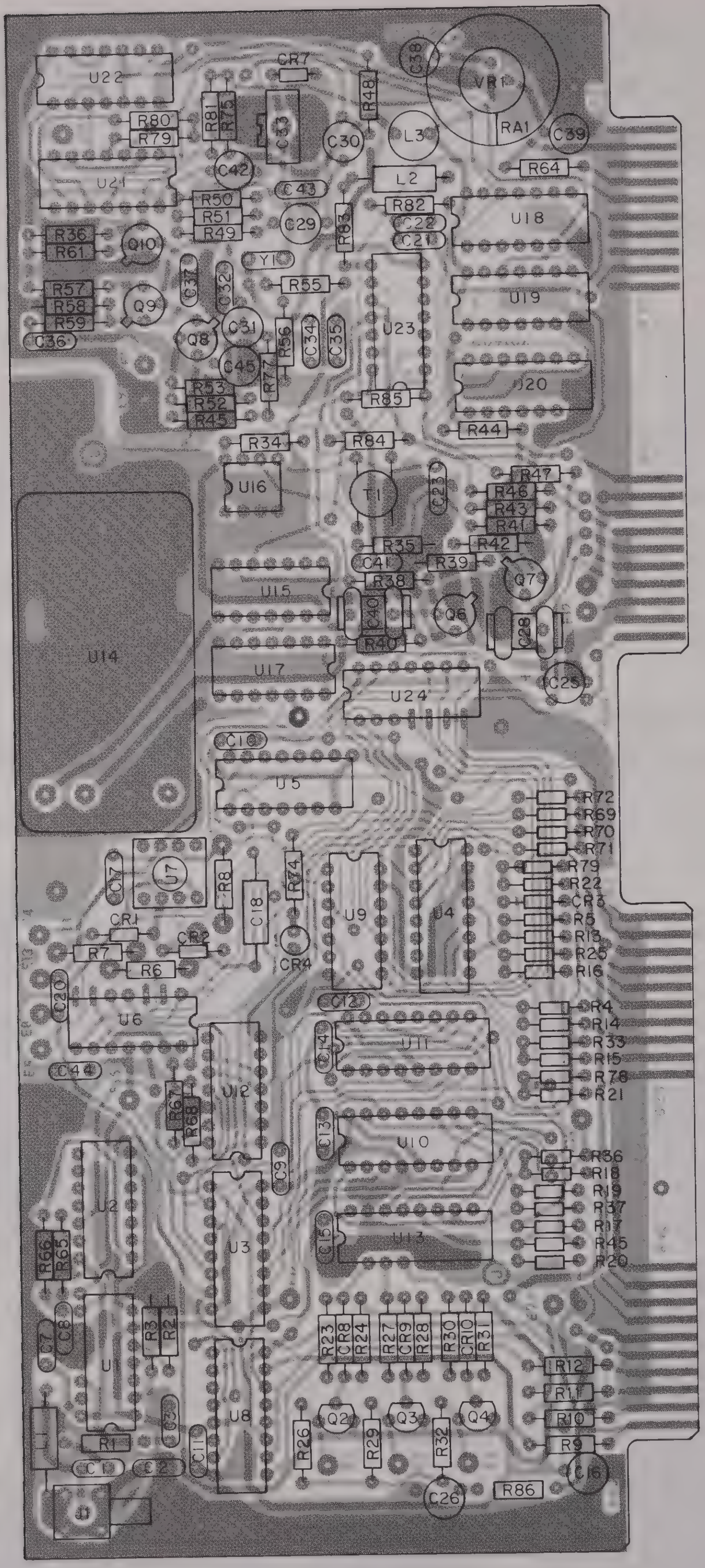


Figure 5-26. Type 791600 1st and 3rd LO Synthesizer (A5A1A2), Location of Components

REF DESIG PREFIX A5A1A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
CR4	Diode: LED	1	5082-4684	28480	
CR5	Not Used				
CR6	Not Used				
CR7	Diode, Varicap	1	BB105B	25088	
CR8	Diode, Zener: 15 V	2	1N965B	80131	04713
CR9	Same as CR8				
CR10	Same as CR8				
J1	Connector, Receptacle: SMC Series	1	50-053-0000	98291	
L1	Coil, Fixed: 0.24 µH	1	200-11	99848	
L2	Coil, Fixed: 8.2 µH	1	1537-34	99800	
L3	Coil, Fixed: 100 µH	1	553-3635-25	71279	
Q1	Not Used				
Q2	Transistor	3	2N4401	80131	04713
Q3	Same as Q2				
Q4	Same as Q2				
Q5	Not Used				
Q6	Transistor	3	2N706	80131	04713
Q7	Same as Q6				
Q8	Transistor	2	2N2222A	80131	04715
Q9	Same as Q8				
Q10	Same as Q6				
R1	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	6	RCR07G101JS	81349	01121
R2	Resistor, Fixed, Composition: 470 Ω, 5%, 1/4 W	4	RCR07G471JS	81349	01121
R3	Same as R2				
R4	Resistor, Fixed, Composition: 82 kΩ, 5%, 1/8 W	4	RCR05G823JS	81349	01121
R5	Same as R4				
R6*	Resistor, Fixed, Composition: 5.6 kΩ, 5%, 1/4 W	4	RCR07G562JS	81349	01121
R7*	Same as R6				
R8*	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	1	RCR07G104JS	81349	01121
R9 Thru R12	Same as R1				
R13	Resistor, Fixed, Composition: 100 Ω, 5%, 1/8 W	10	RCR05G101JS	81349	01121
R14 Thru R22	Same as R13				
R23	Resistor, Fixed, Composition: 2.2 kΩ, 5%, 1/4 W	5	RCR07G222JS	81349	01121
R24	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	6	RCR07G103JS	81349	01121
R25	Same as R4				
R26	Resistor, Fixed, Composition: 20 kΩ, 5%, 1/4 W	3	RCR07G203JS	81349	01121
	* Nominal value, final value factory selected.				

REF DESIG PREFIX A5A1A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R27	Same as R23				
R28	Same as R24				
R29	Same as R26				
R30	Same as R23				
R31	Same as R24				
R32	Same as R26				
R33	Same as R4				
R34	Same as R6				
R35	Same as R6				
R36	Resistor, Fixed, Composition: 27 kΩ, 5%, 1/8 W	3	RCR05G273JS	81349	01121
R37	Same as R36				
R38	Resistor, Fixed, Composition: 2.7 kΩ, 5%, 1/4 W	1	RCR07G272JS	81349	01121
R39	Same as R23				
R40	Resistor, Fixed, Composition: 270 Ω, 5%, 1/4 W	5	RCR07G271JS	81349	01121
R41	Resistor, Fixed, Composition: 4.3 kΩ, 5%, 1/4 W	1	RCR07G432JS	81349	01121
R42	Same as R23				
R43	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	15	RCR07G102JS	81349	01121
R44	Same as R2				
R45	Same as R36				
R46	Same as R40				
R47	Same as R40				
R48	Same as R43				
R49	Resistor, Fixed, Composition: 330 Ω, 5%, 1/4 W	1	RCR07G331JS	81349	01121
R50	Same as R24				
R51	Same as R43				
R52	Same as R43				
R53	Same as R24				
R54	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	3	RCR07G220JS	81349	01121
R55	Resistor, Fixed, Composition: 27 Ω, 5%, 1/4 W	1	RCR07G270JS	81349	01121
R56	Same as R40				
R57	Same as R54				
R58	Resistor, Fixed, Composition: 150 Ω, 5%, 1/4 W	2	RCR07G151JS	81349	01121
R59	Same as R58				
R60	Not Used				
R61	Same as R43				
R62	Not Used				
R63	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
R64	Resistor, Fixed, Composition: 3.3 Ω, 5%, 1/4 W	1	RCR07G3R3JS	81349	01121
R65 Thru R68	Same as R43				
R69	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/8 W	4	RCR05G102JS	81349	01121

REF DESIG PREFIX A5A1A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R70	Same as R69				
R71	Same as R69				
R72	Same as R69				
R73	Same as R24				
R74	Same as R2				
R75	Same as R43				
R76	Same as R43				
R77	Same as R54				
R78	Resistor, Fixed, Composition: 47 kΩ, 5%, 1/8 W	2	RCR05G473JS	81349	01121
R79	Same as R78				
R80	Same as R43				
R81	Same as R43				
R82	Resistor, Fixed, Composition: 47 Ω, 5%, 1/4 W	1	RCR07G470JS	81349	01121
R83	Same as R1				
R84	Same as R43				
R85	Same as R43				
R86	Same as R40				
RA1	Heatsink	1	2225B	13103	
T1	Inductor/Transformer Assembly	1	22295-50	14632	
U1	Integrated Circuit	1	MC12013L	04713	
U2	Integrated Circuit	1	SN74LS196N	01295	
U3	Integrated Circuit	1	MC12014L	04713	
U4	Integrated Circuit	1	841013	14632	
U5	Integrated Circuit	2	MC4044P	04713	
U6	Integrated Circuit	1	SN74LS00N	01295	
U7	Integrated Circuit	1	CA6741T	02735	
U8	Integrated Circuit	3	SN74LS190N	01295	
U9	Integrated Circuit	6	SN74LS196N	01295	
U10	Same as U8				
U11	Same as U8				
U12	Integrated Circuit	1	SN74S74N	01295	
U13	Integrated Circuit	1	SN74184N	01295	
U14	Temperature-Compensated Crystal Oscillator	1	92063-1	14632	
U15	Same as U9				
U16	Integrated Circuit	1	SN75140N	01295	
U17 Thru U20	Same as U9				
U21	Integrated Circuit	1	SN74LS74N	01295	
U22	Same as U5				
U23	Integrated Circuit	1	SN74125N	01295	
U24	Integrated Circuit	1	SN74LS02N	01295	

REF DESIG PREFIX A5A1A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
VR1	Voltage Regulator	1	78M05HC	02763	
Y1	Crystal, Quartz	1	CR64U11.155 MHz	80058	74306

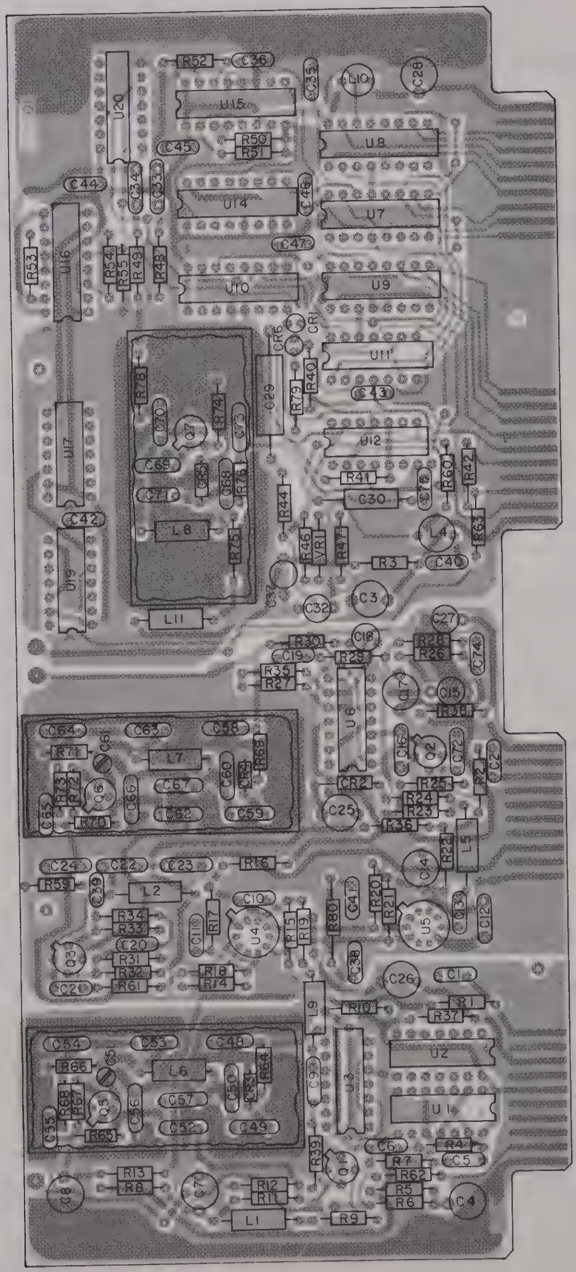


Figure 5-27. Type 791601 2nd LO Synthesizer (A5A2), Location of Components

5.5.5.2 Type 791601 2nd LO Synthesizer REF DESIG PREFIX A5A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	3	34452-1	14632	
C2	Same as C1				
C3	Capacitor, Electrolytic, Tantalum: 47 µF, 20%, 20 V	3	196D476X0020PE4	56289	
C4	Capacitor, Electrolytic, Tantalum: 22 µF, 20%, 10 V	9	196D226X0010JE3	56289	
C5	Capacitor, Electrolytic, Tantalum: 1 µF, 20%, 35 V	2	196D105X035HE3	56289	
C6	Capacitor, Ceramic, Disc: 2200 pF, 10%, 200 V	1	CK06BX222K	81349	56289
C7	Same as C4				
C8	Same as C3				
C9	Capacitor, Mica, Dipped: 12 pF, 5%, 500 V	1	CM05CD120J03	81349	72136
C10	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V	2	34475-1	14632	
C11	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	17	34453-1	14632	
C12	Same as C11				
C13	Same as C10				
C14	Same as C4				
C15	Same as C4				
C16	Capacitor, Ceramic, Disc: 470 pF, 20%, 1000 V	3	B470PFM	91418	
C17	Capacitor, Electrolytic, Tantalum: 150 µF, 20%, 6 V	1	196D157X0006PE4	56289	
C18	Same as C5				
C19	Same as C11				
C20	Same as C11				
C21	Same as C11				
C22	Capacitor, Ceramic, Tubular: 10 pF, ±0.5 pF, 500 V	1	301-000C0H0-100D	72982	
C23	Capacitor, Mica, Dipped: 220 pF, 2%, 500 V	1	CM05FD221G03	81349	72136
C24	Same as C11				
C25	Same as C3				
C26	Same as C4				
C27	Same as C4				
C28	Same as C4				
C29	Capacitor, Plastic, Tubular: 0.022 µF, 5%, 100 V	1	663UW223-5-1W	84411	
C30	Capacitor, Fixed, Plastic: 4700 pF, 10%, 100 V	1	WMF1D47	14655	
C31	Not Used				
C32	Same as C4				
C33	Same as C16				
C34	Same as C16				
C35	Same as C11				
C36	Capacitor, Ceramic, Disc: 1000 pF, GMV, 500 V	8	SM1000PFP	91418	
C37	Same as C4				
C38	Same as C36				
C39	Same as C36				
C40	Same as C11				
C41	Same as C36				

REF DESIG PREFIX A5A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C42 Thru C49	Same as C11				
C50	Capacitor, Ceramic, Tubular: 27 pF, 5%, 500 V	1	308-000C0G0-270J	72982	
C51	Capacitor, Variable, Air: 0.4-2.5 pF, 500 V	2	7283	91293	
C52	Capacitor, Ceramic, Tubular: 6.8 pF, ±0.25 pF, 500 V	2	301-000C0G0-689C	72982	
C53	Capacitor, Ceramic, Tubular: 47 pF, 5%, 500 V	5	308-000C0G0-470J	72982	
C54	Same as C53				
C55	Same as C36				
C56	Capacitor, Ceramic, Tubular: 8.2 pF, ±0.5 pF, 500 V	1	301-000C0H0-829D	72982	
C57*	Capacitor, Ceramic, Tubular: 5.6 pF, ±0.5 pF, 500 V	1	301-000T2J0-569D	72982	
C58	Same as C11				
C59	Capacitor, Ceramic, Tubular: 33 pF, 5%, 500 V	1	308-000C0G0-3305	72982	
C60	Same as C53				
C61	Same as C51				
C62	Same as C52				
C63	Same as C53				
C64	Same as C53				
C65	Same as C36				
C66*	Capacitor, Ceramic, Tubular: 2.7 pF, ±0.25 pF, 500 V	1	301-000C0J0-279C	72982	
C67	Capacitor, Ceramic, Tubular: 5.6 pF, ±0.5 pF, 500 V	1	301-000U2J0-5690	72982	
C68	Capacitor, Mica, Dipped: 150 pF, 2%, 500 V	1	CM05FD151G03	81349	72136
C69	Capacitor, Ceramic, Tubular: 4.7 pF, ±0.1 pF, 500 V	1	301-000C0H0-479B	72982	
C70	Capacitor, Ceramic, Tubular: 2.2 pF, ±0.25 pF, 500 V	1	301-000C0J0-229C	72982	
C71	Capacitor, Ceramic, Tubular: 15 pF, 5%, 500 V	1	301-000C0G0-150J	72982	
C72	Capacitor, Mica, Dipped: 1000 pF, 5%, 100 V	1	DM15-102J	72136	
C73	Same as C36				
C74	Same as C1				
C75	Capacitor, Ceramic, Disc: 100 pF, 2%, 500 V	1	CM04FD101G03	81349	72136
CR1	Diode: LED	2	5082-4684	28480	
CR2	Diode	1	1N4446	80131	93332
CR3	Diode, Varicap	3	BB109-YELLOW	25088	
CR4	Same as CR3				
CR5	Same as CR3				
CR6	Same as CR1				
L1	Coil, Fixed, Molded: 0.47 µH	1	1537-06	99800	
L2	Coil, Fixed, Molded: 1.5 µH	1	1537-16	99800	
L3	Not Used				
L4	Coil, Fixed: 22 mH	1	553-3635-53	71279	
	* Nominal value, final value factory selected.				

REF DESIG PREFIX A5A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
L5	Coil, Fixed, Molded: 680 μH	1	2500-20	99800	
L6	Coil, Fixed: 0.82 μH	2	1537-10	99800	
L7	Same as L6				
L8	Inductor	1	21210-183	14632	
L9	Coil, Fixed: 2.2 μH	1	1025-28	99800	
L10	Coil, Fixed: 10 μH	1	553-3635-13	71279	
L11	Coil, Fixed: 100 μH	1	1537-76	99800	
Q1	Transistor	3	2N2857	80131	02735
Q2	Transistor	1	2N2222A	80131	04713
Q3	Transistor	1	841001-1	14632	
Q4	Not Used				
Q5	Same as Q1				
Q6	Same as Q1				
Q7	Transistor	1	U310	17856	
R1	Resistor, Fixed, Composition: 22 Ω, 5%, 1/4 W	4	RCR07G220JS	81349	01121
R2	Same as R1				
R3	Same as R1				
R4	Resistor, Fixed, Composition: 1.8 kΩ, 5%, 1/4 W	1	RCR07G182JS	81349	01121
R5	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	7	RCR07G100JS	81349	01121
R6	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	13	RCR07G102JS	81349	01121
R7	Resistor, Fixed, Composition: 1.2 kΩ, 5%, 1/4 W	1	RCR07G122JS	81349	01121
R8	Same as R5				
R9	Same as R6				
R10	Resistor, Fixed, Composition: 5.6 Ω, 5%, 1/4 W	1	RCR07G5R6JS	81349	01121
R11	Resistor, Fixed, Composition: 5.1 kΩ, 5%, 1/4 W	1	RCR07G512JS	81349	01121
R12	Same as R6				
R13	Same as R5				
R14	Same as R6				
R15	Resistor, Fixed, Composition: 47 Ω, 5%, 1/4 W	8	RCR07G470JS	81349	01121
R16	Same as R15				
R17	Same as R15				
R18	Same as R15				
R19	Resistor, Fixed, Composition: 820 Ω, 5%, 1/4 W	1	RCR07G821JS	81349	01121
R20	Resistor, Fixed, Composition: 2.2 kΩ, 5%, 1/4 W	2	RCR07G222JS	81349	01121
R21	Same as R20				
R22	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	1	RCR07G101JS	81349	01121
R23	Resistor, Fixed, Composition: 18 kΩ, 5%, 1/4 W	1	RCR07G183JS	81349	01121
R24	Same as R6				
R25	Same as R6				
R26	Same as R5				
R27	Resistor, Fixed, Composition: 2.7 kΩ, 5%, 1/4 W	2	RCR07G272JS	81349	01121

REF DESIG PREFIX A5A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R28	Same as R5				
R29	Same as R6				
R30	Resistor, Fixed, Composition: 680 Ω, 5%, 1/4 W	1	RCR07G681JS	81349	01121
R31	Resistor, Fixed, Composition: 1.0 MΩ, 5%, 1/4 W	1	RCR07G105JS	81349	01121
R32	Resistor, Fixed, Composition: 820 kΩ, 5%, 1/4 W	1	RCR07G824JS	81349	01121
R33	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	1	RCR07G104JS	81349	01121
R34	Resistor, Fixed, Composition: 360 Ω, 5%, 1/4 W	1	RCR07G361JS	81349	01121
R35	Same as R27				
R36	Same as R5				
R37	Resistor, Fixed, Composition: 4.7 Ω, 5%, 1/4 W	1	RCR07G4R7JS	81349	01121
R38	Same as R5				
R39	Resistor, Fixed, Composition: 56 Ω, 5%, 1/4 W	1	RCR07G560JS	81349	01121
R40	Resistor, Fixed, Composition: 470 Ω, 5%, 1/4 W	5	RCR07G471JS	81349	01121
R41	Same as R6				
R42	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	4	RCR07G103JS	81349	01121
R43	Not Used				
R44	Resistor, Fixed, Composition: 47 kΩ, 5%, 1/4 W	1	RCR07G473JS	81349	01121
R45	Not Used				
R46	Resistor, Fixed, Composition: 1.5 kΩ, 5%, 1/4 W	1	RCR07G152JS	81349	01121
R47	Resistor, Fixed, Composition: 750 Ω, 5%, 1/4 W	1	RCR07G751JS	81349	01121
R48	Same as R15				
R49	Same as R15				
R50	Same as R40				
R51	Same as R40				
R52	Same as R6				
R53	Same as R6				
R54	Same as R40				
R55	Same as R40				
R56	Not Used				
R57	Not Used				
R58	Not Used				
R59	Same as R15				
R60	Same as R6				
R61	Same as R6				
R62	Same as R42				
R63	Same as R42				
R64	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/8 W	3	RCR05G103JS	81349	01121
R65	Resistor, Fixed, Film: 18.2 kΩ, 1%, 1/10 W	4	RN55C1822F	81349	75042
R66	Same as R65				
R67	Resistor, Fixed, Composition: 22 Ω, 5%, 1/8 W	2	RCR05G220JS	81349	01121
R68	Resistor, Fixed, Film: 3.92 kΩ, 1%, 1/10 W	2	RN55C3921F	81349	75042

REF DESIG PREFIX A5A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R69	Same as R64				
R70	Same as R65				
R71	Same as R65				
R72	Same as R67				
R73	Same as R68				
R74	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
R75	Same as R1				
R76	Same as R64				
R77	Not Used				
R78	Same as R15				
R79	Same as R42				
R80	Same as R6				
U1	Integrated Circuit	3	MC4044P	04713	
U2	Integrated Circuit	1	868281	14632	
U3	Integrated Circuit	1	SN74S74N	01295	
U4	Integrated Circuit	1	MC1496	04713	
U5	Integrated Circuit	1	N5733K	18324	
U6	Same as U1				
U7	Integrated Circuit	1	SN74LS190N	01295	
U8	Integrated Circuit	3	SN74LS191N	01295	
U9	Same as U8				
U10	Same as U8				
U11	Integrated Circuit	2	SN74LS00N	01295	
U12	Same as U1				
U13	Not Used				
U14	Integrated Circuit	1	SN74LS168N	01295	
U15	Integrated Circuit	2	MC12013P	04713	
U16	Same as U15				
U17	Integrated Circuit	2	SN74LS196N	01295	
U18	Not Used				
U19	Same as U17				
U20	Same as U11				
VR1	Diode, Zener: 8.2 V	1	1N756A	80131	04713

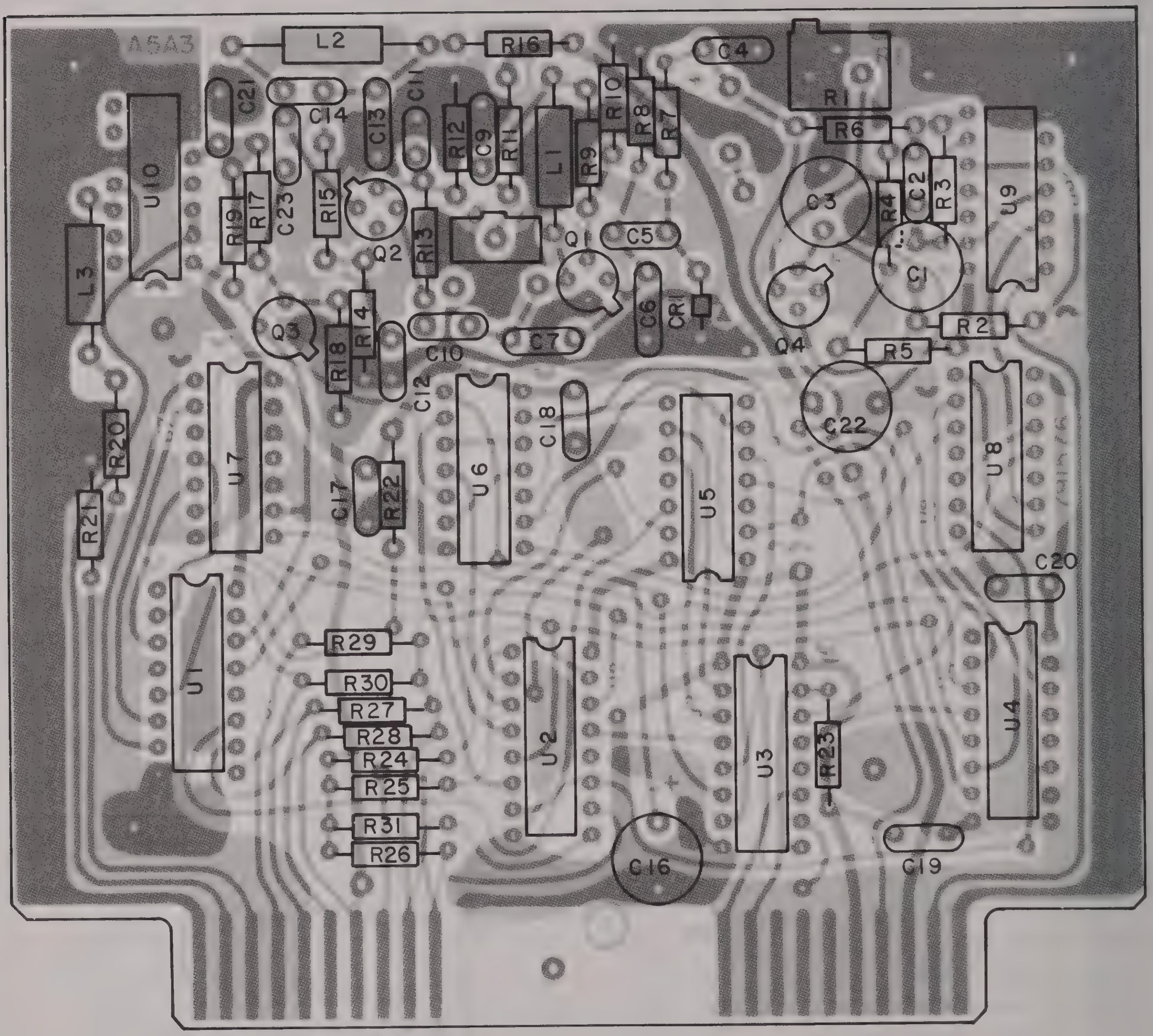


Figure 5-28. Type 791576 BFO Synthesizer (A5A3), Location of Components

5.5.5.3 Type 791576 BFO Synthesizer REF DESIG PREFIX A5A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Electrolytic, Tantalum: 3.3 µF, 20%, 35 V	1	196D335X0035JE3	56289	
C2	Capacitor, Ceramic, Disc: 0.1 µF, 20%, 50 V	1	34475-1	14632	
C3	Capacitor, Electrolytic, Tantalum: 47 µF, 20%, 20 V	3	196D476X0020PE4	56289	
C4	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	1	34452-1	14632	
C5	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	9	34453-1	14632	
C6	Capacitor, Ceramic, Tubular: 33 pF, 5%, 500 V	1	308-000C0G0-330J	72982	
C7	Capacitor, Ceramic, Tubular: 47 pF, 5%, 500 V	1	308-000C0G0-470J	72982	
C8	Capacitor, Variable, Ceramic: 2-8 pF, 350 V	1	538-006A2-8	72982	
C9	Same as C5				
C10	Capacitor, Mica, Dipped: 10 pF, ±0.5 pF, 500 V	2	CM04CD100D03	81349	72136
C11	Capacitor, Ceramic, Disc: 1000 pF, GMV, 500 V	2	SM1000PFP	91418	
C12	Same as C11				
C13	Same as C5				
C14	Same as C10				
C15	Not Used				
C16	Same as C3				
C17 Thru C21	Same as C5				
C22	Same as C3				
C23	Same as C5				
CR1	Diode, Varicap	1	BB109-YELLOW	25088	
L1	Coil, Fixed: 27 µH	1	1537-48	99800	
L2	Coil, Fixed, Molded: 330 µH	1	2500-04	99800	
L3	Coil, Fixed: 0.82 µH	1	1537-10	99800	
Q1	Transistor	1	2N2857	80131	02735
Q2	Transistor	1	841001-2	14632	
Q3	Transistor	1	2N706	80131	04713
Q4	Transistor	1	3N128	80131	02735
R1	Resistor, Variable, Film: 500 Ω, 10%, 1/2 W	1	62PAR500	73138	
R2	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	15	RCR07G102JS	81349	01121
R3	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	3	RCR07G103JS	81349	01121
R4	Same as R2				
R5	Resistor, Fixed, Composition: 10 Ω, 5%, 1/4 W	3	RCR07G100JS	81349	01121
R6	Same as R2				
R7	Same as R3				
R8	Resistor, Fixed, Film: 4.22 kΩ, 1%, 1/10 W	1	RN55C4221F	81349	75042
R9	Resistor, Fixed, Film: 17.8 kΩ, 1%, 1/10 W	2	RN55C1782F	81349	75042
R10	Same as R9				
R11	Same as R5				
R12	Resistor, Fixed, Composition: 560 Ω, 5%, 1/4 W	1	RCR07G561JS	81349	01121
R13	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	1	RCR07G104JS	81349	01121

REF DESIG PREFIX A5A3

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
R14	Resistor, Fixed, Composition: 1.0 MΩ, 5%, 1/4 W	1	RCR07G105JS	81349	01121
R15	Resistor, Fixed, Composition: 820 kΩ, 5%, 1/4 W	1	RCR07G824JS	81349	01121
R16	Same as R5				
R17	Same as R3				
R18	Same as R2				
R19	Same as R2				
R20	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	1	RCR07G221JS	81349	01121
R21	Resistor, Fixed, Composition: 62 Ω, 5%, 1/4 W	1	RCR07G620JS	81349	01121
R22 Thru R31	Same as R2				
U1	Integrated Circuit	4	SN74LS190N	01295	
U2 Thru U4	Same as U1				
U5	Integrated Circuit	2	SN7425N	01295	
U6	Integrated Circuit	1	SN74LS11N	01295	
U7	Same as U5				
U8	Integrated Circuit	1	867474	14632	
U9	Integrated Circuit	1	MC4044P	04713	
U10	Integrated Circuit	1	SN74LS90N	01295	

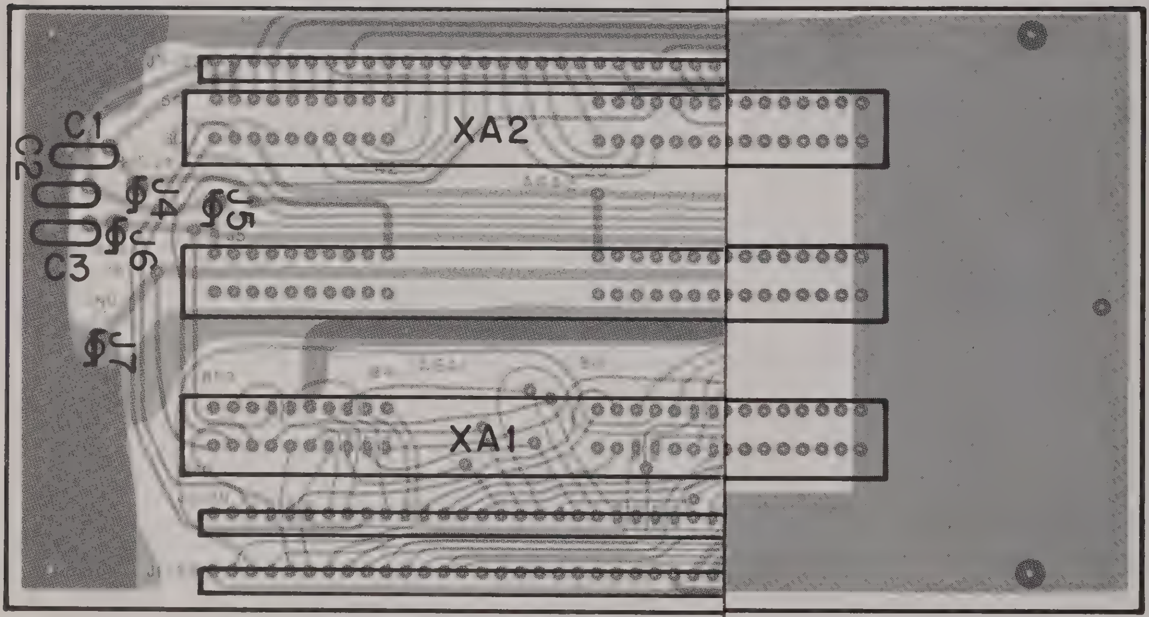


Figure 5-29. Type 791580 I/O Motherboard (A6), Location of Components

5.5.6 TYPE 791580 I/O MOTHERBOARD REF DESIG PREFIX A6

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1*	Manual Tune Up/Down Counter	1	791575-2	14632	
A2	Front Panel Interconnect	1	791828	14632	
C1	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 50 V	3	34452-1	14632	
C2	Same as C1				
C3	Same as C1				
J1	Post, Feedthru	3	PE7-14045	00779	
J2	Same as J1				
J3	Same as J1				
J4	Faston Tabs	4	62073-1	00779	
J5	Same as J4				
J6	Same as J4				
J7	Same as J4				
MP1	Housing, P.C. Connector	9	117798-3	00779	
MP2 Thru MP9	Same as MP1				
XA1	Contract Strip	36	PE7-14046	00779	
XA2	Same as XA1				
	* Part of MCM-2 Option.				

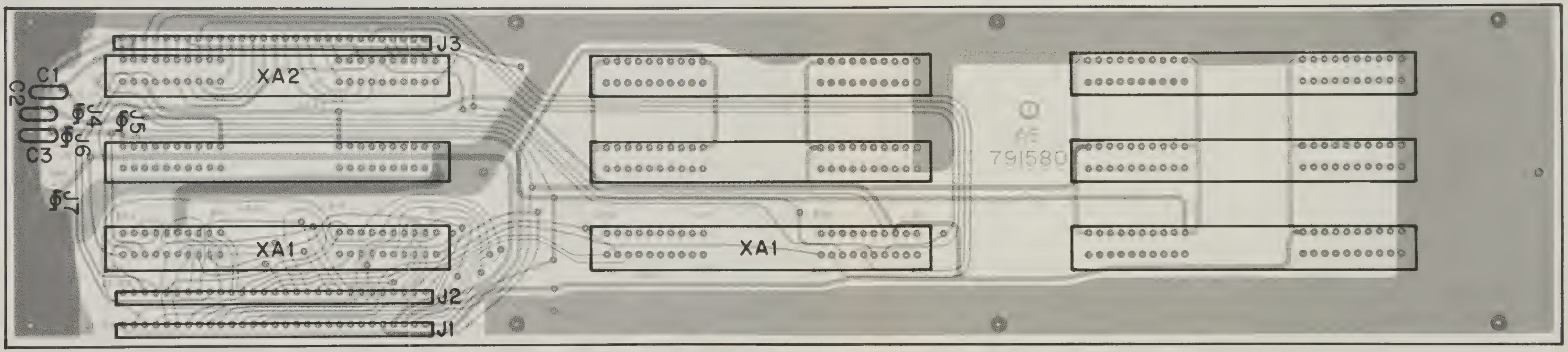


Figure 5-29. Type 791580 I/O Motherboard (A6),
Location of Components

5.5.6 TYPE 791580 I/O MOTHERBOARD REF DESIG PREFIX A6

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1*	Manual Tune Up/Down Counter	1	791575-2	14632	
A2	Front Panel Interconnect	1	791828	14632	
C1	Capacitor, Ceramic, Disc: 0.47 μF, 20%, 50 V	3	34452-1	14632	
C2	Same as C1				
C3	Same as C1				
J1	Post, Feedthru	3	PE7-14045	00779	
J2	Same as J1				
J3	Same as J1				
J4	Faston Tabs	4	62073-1	00779	
J5	Same as J4				
J6	Same as J4				
J7	Same as J4				
MP1	Housing, P.C. Connector	9	117798-3	00779	
MP2 Thru MP9	Same as MP1				
XA1	Contract Strip	36	PE7-14046	00779	
XA2	Same as XA1				
	* Part of MCM-2 Option.				

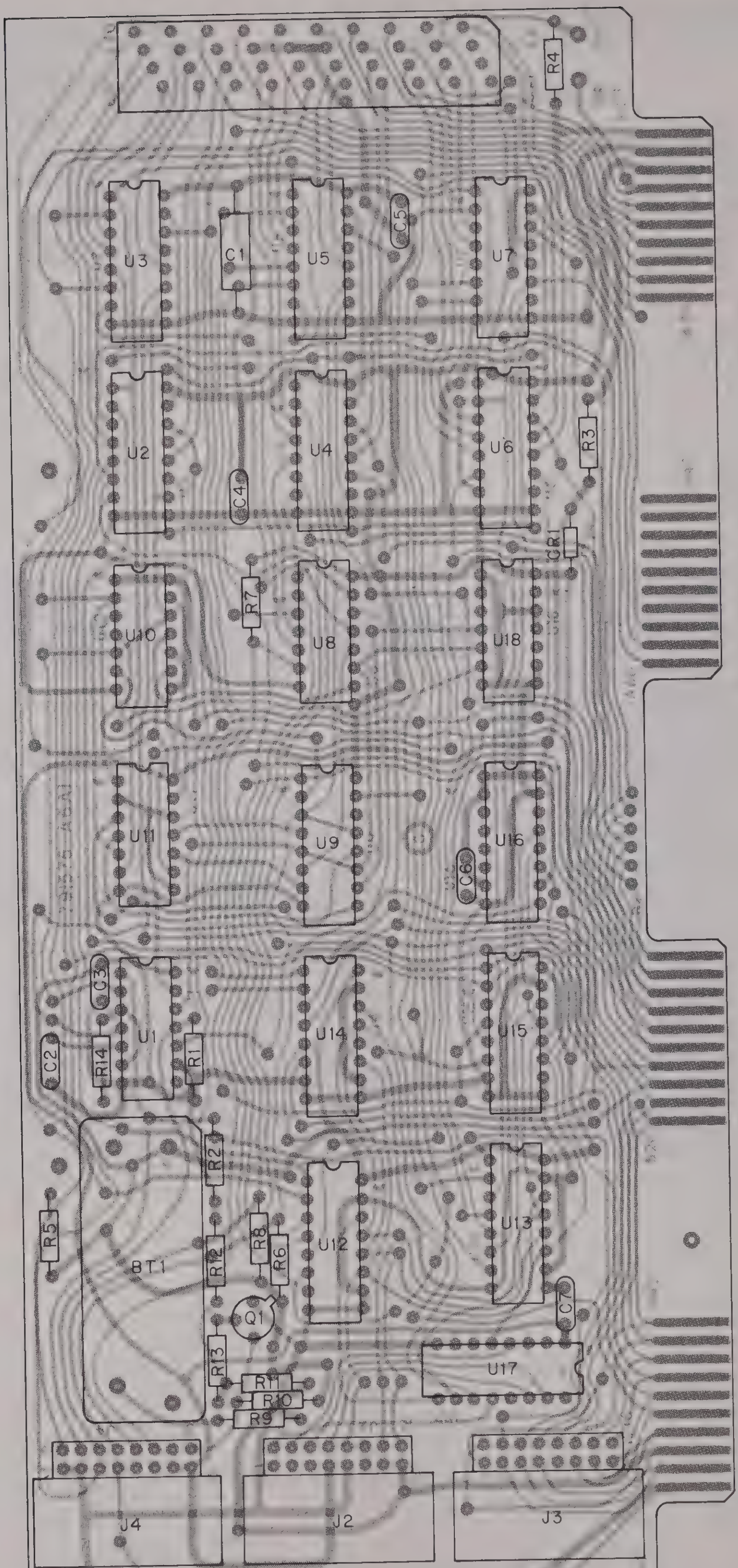


Figure 5-30. Type 791575-2 Tuning Up/Down Counter (A6A1), Location of Components

5.5.6.1 Type 791575-2 Manual Tuning Up/Down Counter* REF DESIG PREFIX A6A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
BT1	Battery	1	41B901BD16G1	19209	
C1	Capacitor, Electrolytic, Tantalum: 22 µF, 10%, 15 V	1	CS13BE226K	81349	56280
C2	Capacitor, Ceramic, Disc: 470 pF, 20%, 1000 V	1	B470PFM	91418	
C3	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	5	34453-1	14632	
C4 Thru C7	Same as C3				
CR1	Diode	1	5082-2900	28480	
J1	Connector, Multipin	1	609-37S	26342	
J2	Connector: Right Angle Header	3	87567-4	00779	
J3	Same as J2				
J4	Same as J2				
Q1	Transistor	1	2N2222A	80131	04713
R1	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	7	RCR07G103JS	81349	01121
R2	Same as R1				
R3	Resistor, Fixed, Composition: 4.7 Ω, 5%, 1/4 W	1	RCR07G4R7JS	81349	01121
R4	Resistor, Fixed, Composition: 1.0 kΩ, 5%, 1/4 W	3	RCR07G102JS	81349	01121
R5 Thru R8	Same as R1				
R9	Resistor, Fixed, Composition: 470 Ω, 5%, 1/4 W	1	RCR07G471JS	81349	01121
R10	Same as R1				
R11	Same as R4				
R12	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	1	RCR07G101JS	81349	01121
R13	Same as R4				
R14	Resistor, Fixed, Composition: 470 kΩ, 5%, 1/4 W	1	RCR07G474JS	81349	01121
U1	Integrated Circuit	1	MM74C14N	27014	
U2	Integrated Circuit	6	MC14510BCP	04713	
U3 Thru U7	Same as U2				
U8	Integrated Circuit	3	MC14081BCP	04713	
U9	Integrated Circuit	1	MC14027BCP	04713	
U10	Integrated Circuit	1	MC14070BCP	04713	
U11	Same as U8				
U12	Integrated Circuit	4	MC14512CP	04713	
U13	Same as U12				
U14	Same as U12				
U15	Same as U12				
U16	Integrated Circuit	1	MC14520BCP	04713	
U17	Integrated Circuit	1	MC14050BCP	04713	
U18	Same as U8				
	* Part of MCM-2 Option.				

5.5.6.2 Type 791828 Front Panel Interconnect REF DESIG PREFIX A6A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.47 µF, 20%, 50 V	1	34452-1	14632	
CR1	Diode	11	1N995	80131	04713
CR2 Thru CR11	Same as CR1				
J1	Connector: Right Angle Header	1	1-87567-6	00779	
Q1	Transistor	1	2N4037	80131	02735
R1	Resistor, Fixed, Composition: 620 Ω, 5%, 1/4 W	1	RCR07G621JS	81349	01121
R2	Resistor, Fixed, Composition: 100 Ω, 5%, 1/4 W	1	RCR07G101JS	81349	01121
R3	Resistor, Fixed, Composition: 2.7 kΩ, 5%, 1/4 W	1	RCR07G2R7JS	81349	01121
R4	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	1	RCR07G104JS	81349	01121
R5	Resistor, Fixed, Composition: 22 Ω, 5%, 1/2 W	1	RCR20G220JS	81349	01121
R6	Resistor, Fixed, Composition: 10 kΩ, 5%, 1/4 W	2	RCR07G103JS	81349	01121
R7	Same as R6				
U1	Integrated Circuit	1	MC14053BCP	04713	

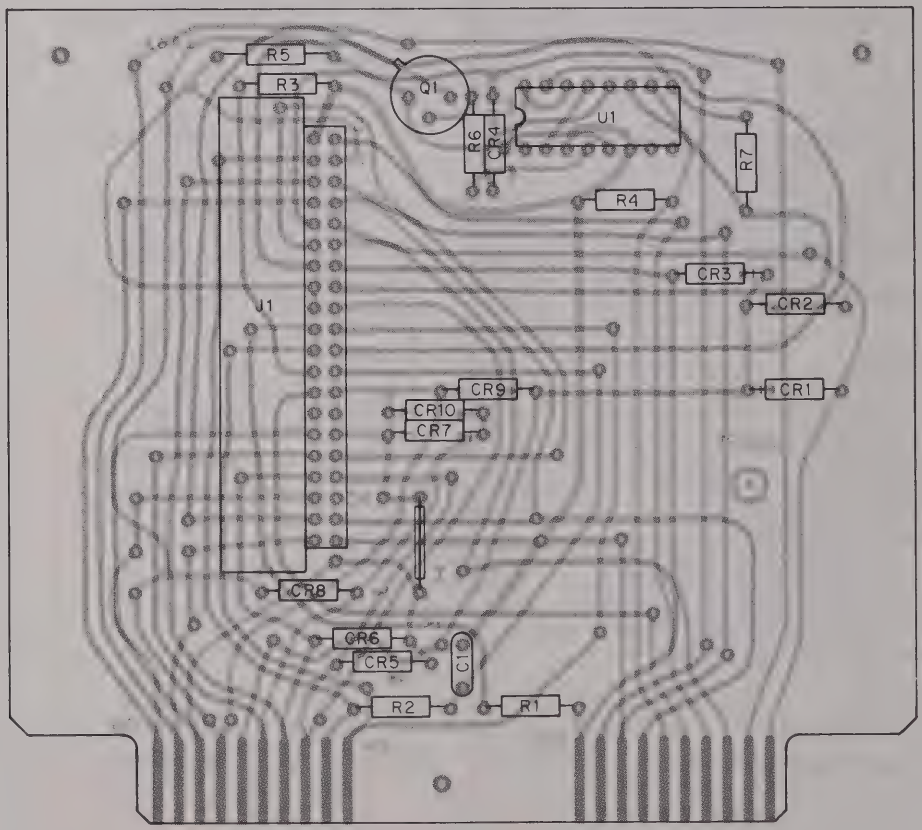


Figure 5-31. Type 791828 Front Panel Interconnect (A6A2), Location of Components

5.5.7 TYPE 791874-1 MANUAL TUNING MODULE* REF DESIG PREFIX A7

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
A1	Tuning Resolution	1	791589	14632	
MP1	Knob Assembly	1	280064-1	14632	
MP2	Button: Black Shell with Green Indicator	5	FA101-BLKW/GRN	31918	
MP3 Thru MP6	Same as MP2				
U1	Encoder Assembly	1	34836-1	14632	
	* Part of MCM-2 Option.				

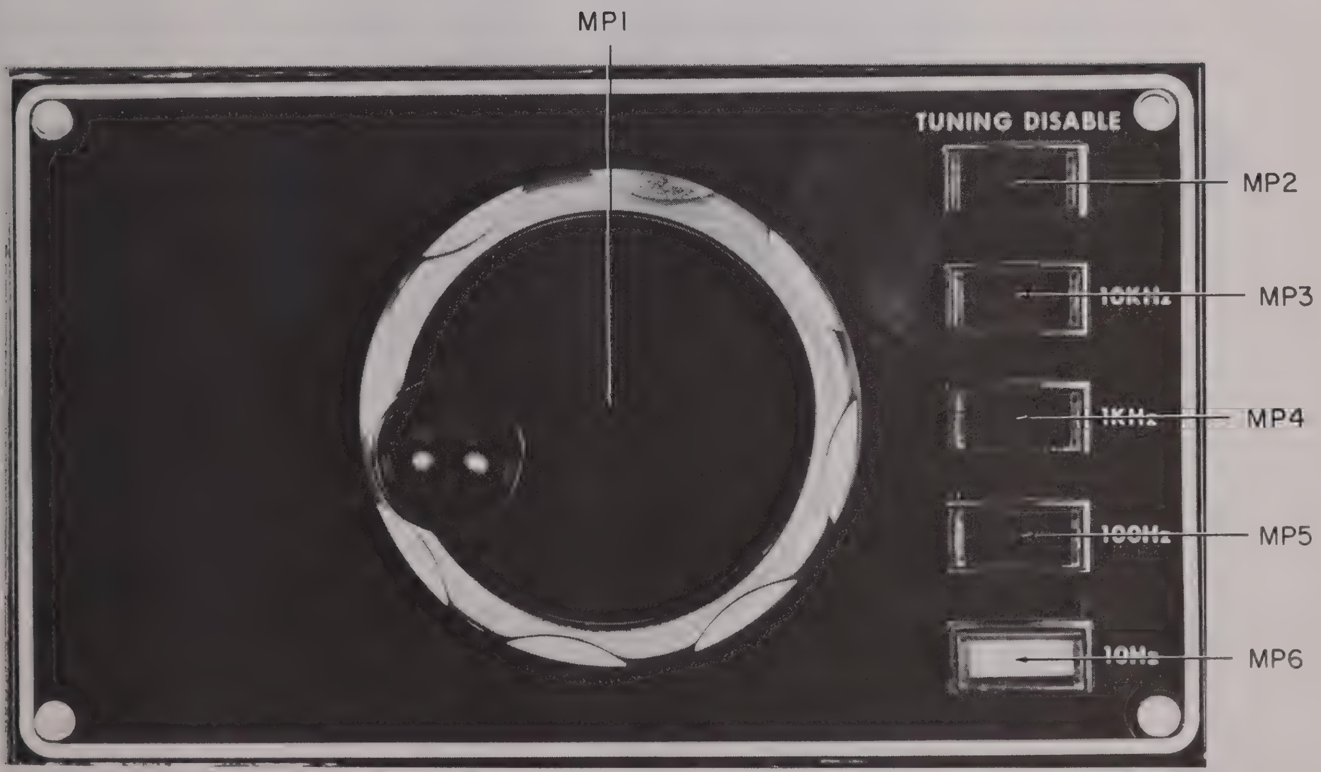


Figure 5-32. Type 791874-1 Manual Tuning Module (A7), Location of Components

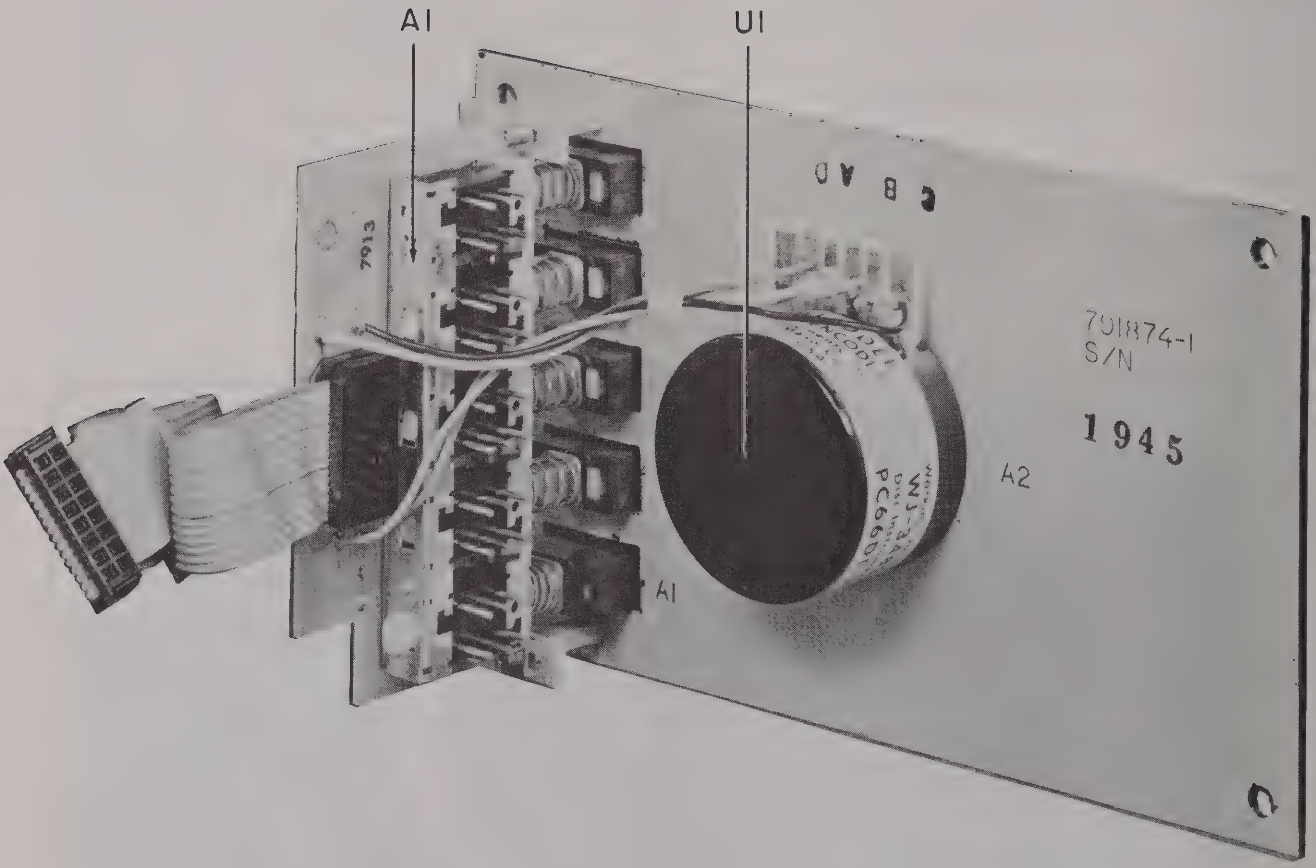


Figure 5-33. Type 791874-1 Manual Tuning Module (A7), Rear View, Location of Components

5.5.7.1 Type 791589 Tuning Resolution

REF DESIG PREFIX A7A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
--	Cable Assembly	1	34524-2	14632	
P1	Connector, Plug	1	88475-3	00779	
S1	Switch, Pushbutton	1	18488	14632	

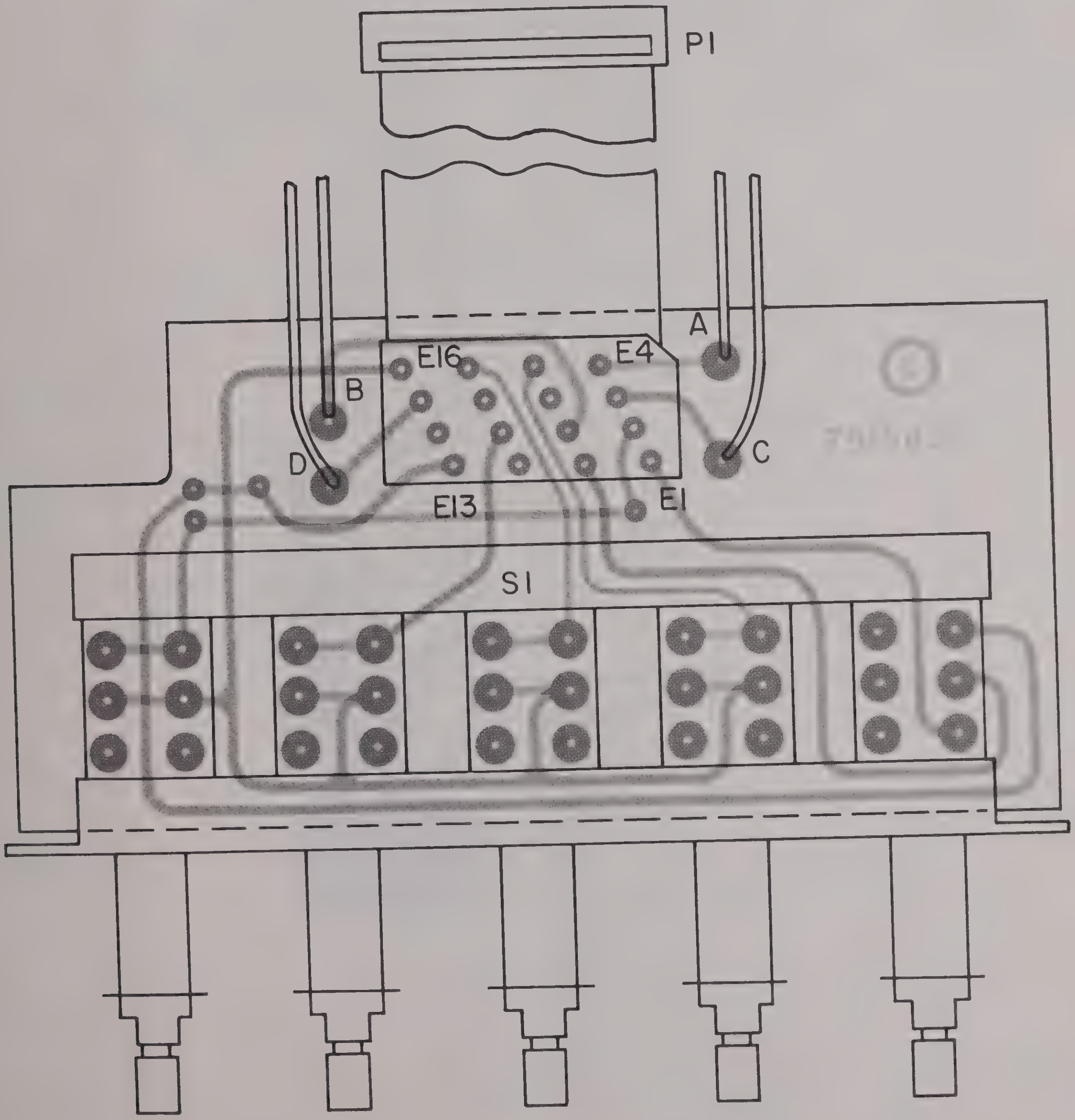


Figure 5-34. Type 791589 Tuning Resolution (A7A1), Location of Components

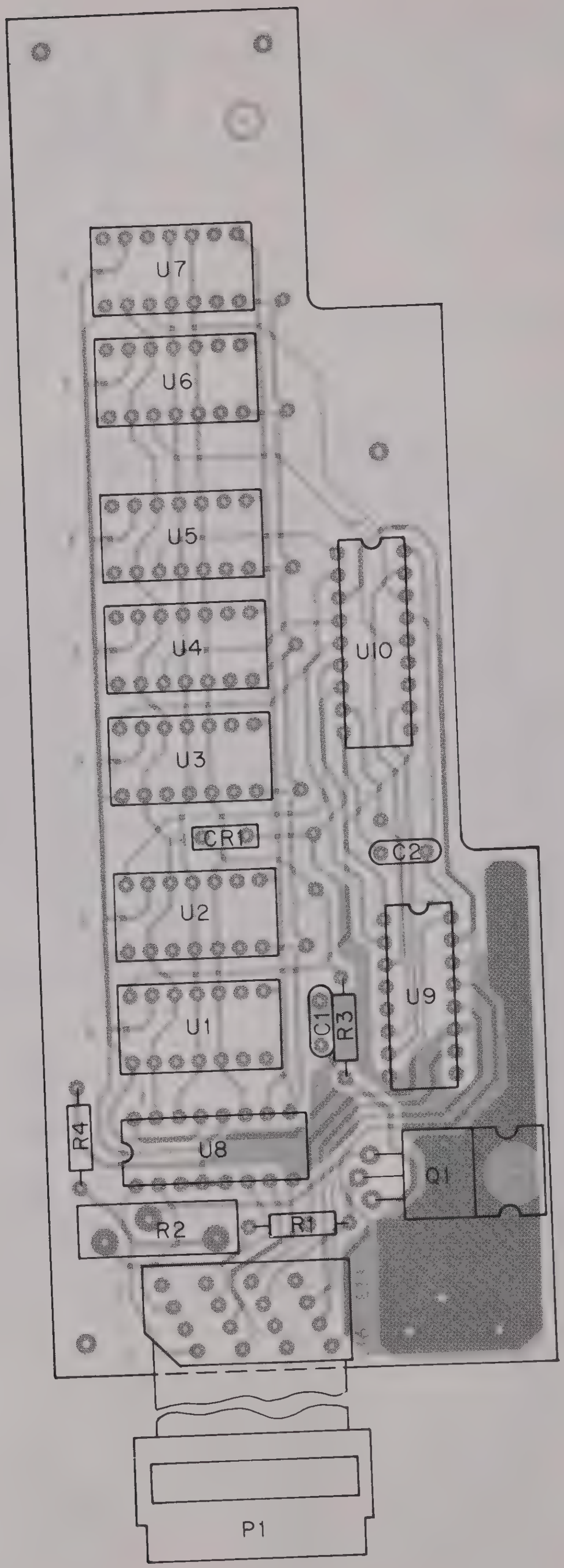


Figure 5-35. Type 791578 Frequency Display (A8), Location of Components

5.5.8 TYPE 791578 FREQUENCY DISPLAY REF DESIG PREFIX A8

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
C1	Capacitor, Ceramic, Disc: 0.01 µF, 20%, 50 V	2	34453-1	14632	
C2	Same as C1				
CR1	Diode: LED	1	5082-4150	28480	
- -	Cable Assembly	1	34525-1	14632	
P1	Connector, Plug	1	88011-2	00779	
Q1	Transistor	1	TIP-29	01295	
R1	Resistor, Fixed, Composition: 47 Ω, 5%, 1/4 W	1	RCR07G470JS	81349	01121
R2	Resistor, Variable, Film: 100 Ω, 10%, 3/4 W	1	89PR100	73138	
R3	Resistor, Fixed, Composition: 820 Ω, 5%, 1/4 W	1	RCR07G821JS	81349	01121
R4	Resistor, Fixed, Composition: 200 Ω, 5%, 1/4 W	1	RCR07G201JS	81349	01121
U1	Integrated Circuit	7	5082-7663	28480	
U2 Thru U7	Same as U1				
U8	Integrated Circuit	1	DS88857N	27014	
U9	Integrated Circuit	1	CD4028AE	02735	
U10	Integrated Circuit	1	DS88863N	27014	
XCR1	Receptacle Pin	2	3-116141-2	00779	
XCR2	Same as XCR1				
XU1	Socket, Integrated Circuit	7	583527-1	00779	
XU2 Thru XU7	Same as XU1				

5.5.9 TYPE 791827 BFO SWITCH

REF DESIG PREFIX A9

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
- -	Cable Assembly	1	34524-1	14632	
P1	Connector, Plug	1	88475-3	00779	
S1	Switch, Thumbwheel	1	339910490-00226	09353	

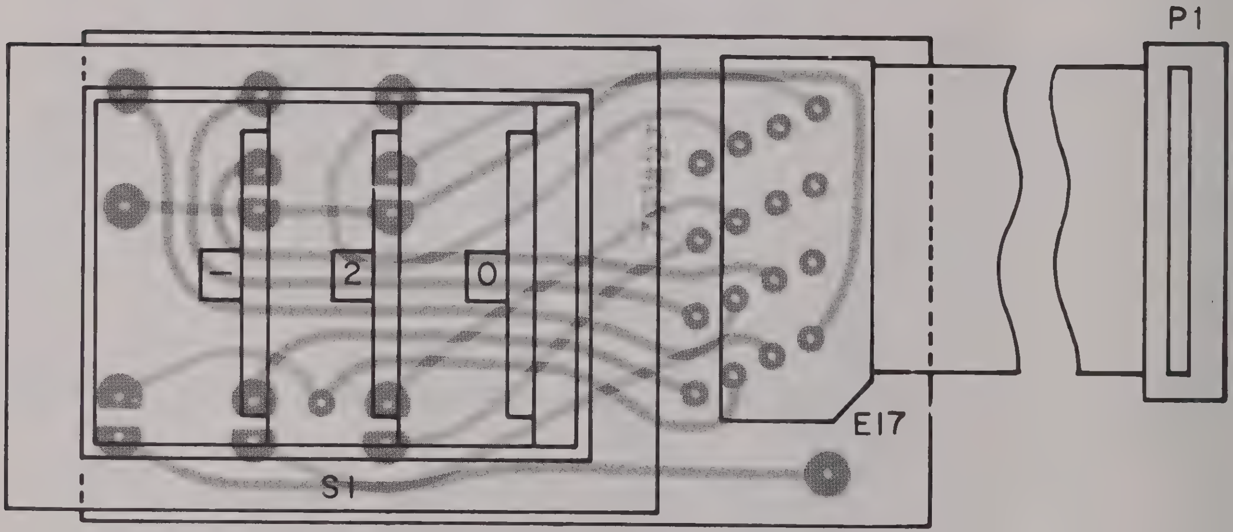


Figure 5-36. Type 791827 BFO Switch (A9), Location of Components

5.5.10 TYPE 791684-2 FRONT PANEL CONTROL REF DESIG PREFIX A10

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	R VEN
A1	Upper Panel	1	791583	14632	
A2	Lower Panel Control	1	791826	14632	
- -	Cable Assembly	1	34528	14632	
P1	Connector, Plug: Ribbon	1	88476-7	00779	

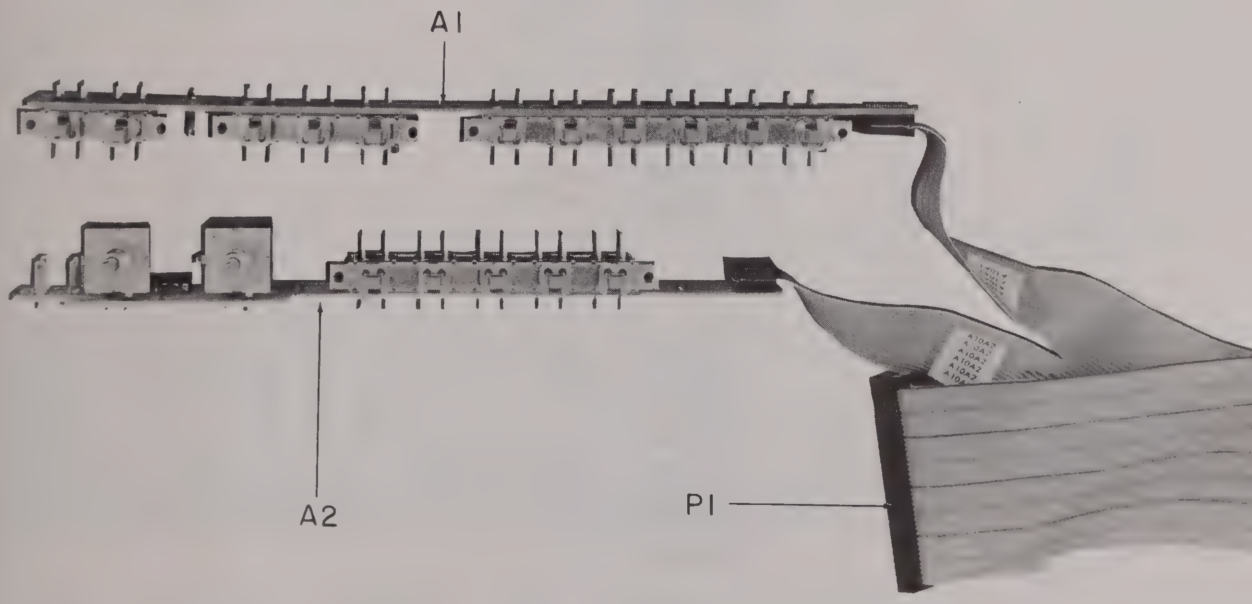


Figure 5-37. Type 791684-2 Front Panel Control (A10), Location of Components

5.5.10.1 Type 791583 Upper Panel Control REF DESIG PREFIX A10A1

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
J1	Faston Receptacle	1	62073-1	00779	
S1	Switch, Pushbutton	1	18485	14632	
S2	Switch, Pushbutton	1	18486	14632	
S3	Switch, Pushbutton	1	18487	14632	

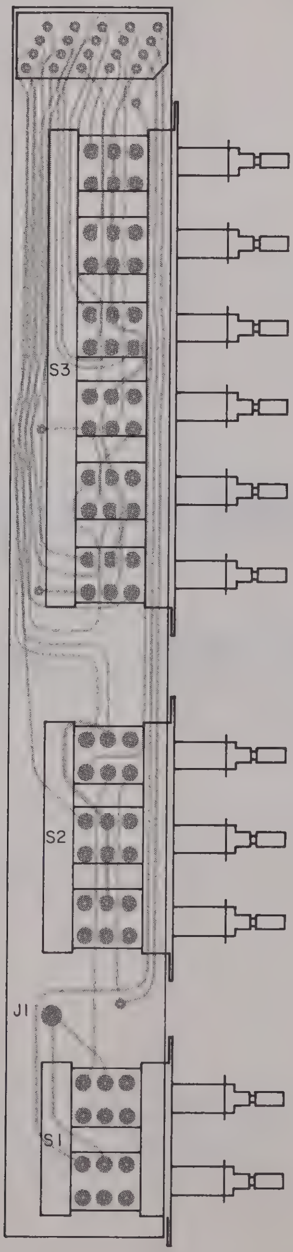


Figure 5-38. Type 791583 Upper Panel Control (A10A1), Location of Components

5.5.10.2 Type 791826 Lower Panel Control REF DESIG PREFIX A10A2

REF DESIG	DESCRIPTION	QTY. PER ASSY.	MANUFACTURER'S PART NO.	MFR. CODE	RECM. VENDOR
J1	Faston Tables	4	62073-1	00779	
J2	Same as J1				
J3	Same as J1				
J4	Same as J1				
R1	Resistor, Variable, Composition: 25 kΩ, 10%, 1 W	1	70M3N056L253U	01121	
R2	Resistor, Variable, Composition, Dual: 25 k/25 kΩ, 10%, 1 W	1	70P3N056L253A	01121	
R3	Resistor, Fixed, Composition: 220 Ω, 5%, 1/4 W	2	RCR07G221JS	81349	01121
R4	Same as R3				
R5	Resistor, Fixed, Composition: 100 kΩ, 5%, 1/4 W	2	RCR07G104JS	81349	01121
R6	Resistor, Fixed, Composition: 1 kΩ, 5%, 1/4 W	2	RCR07G102JS	81349	01121
R7	Same as R5				
R8	Same as R6				
S1	Switch, Pushbutton	1	18488	14632	
U1	Integrated Circuit	1	MC3403P	04713	

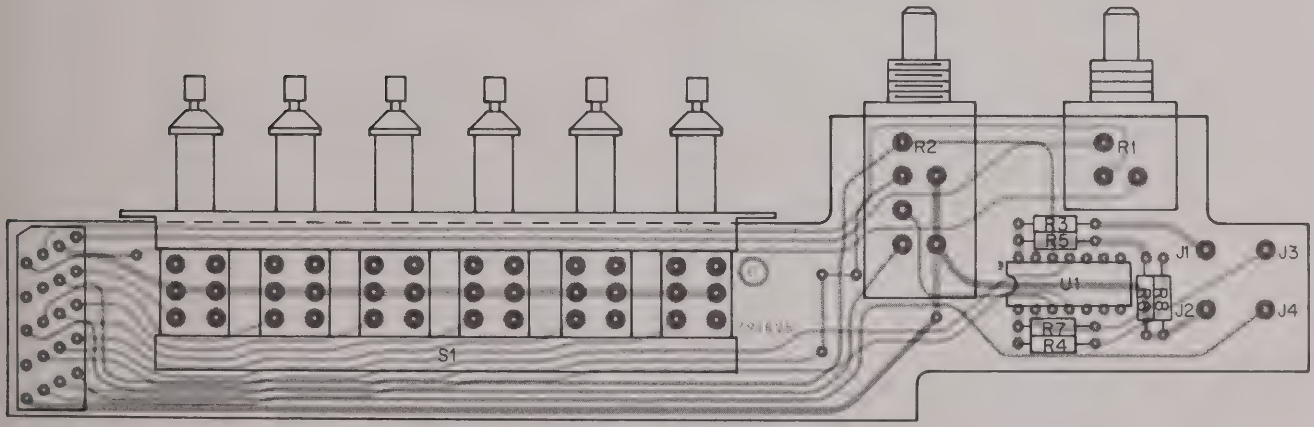


Figure 5-39. Type 791826 Lower Panel Control (A10A2), Location of Components

SECTION VI

SCHEMATIC DIAGRAMS

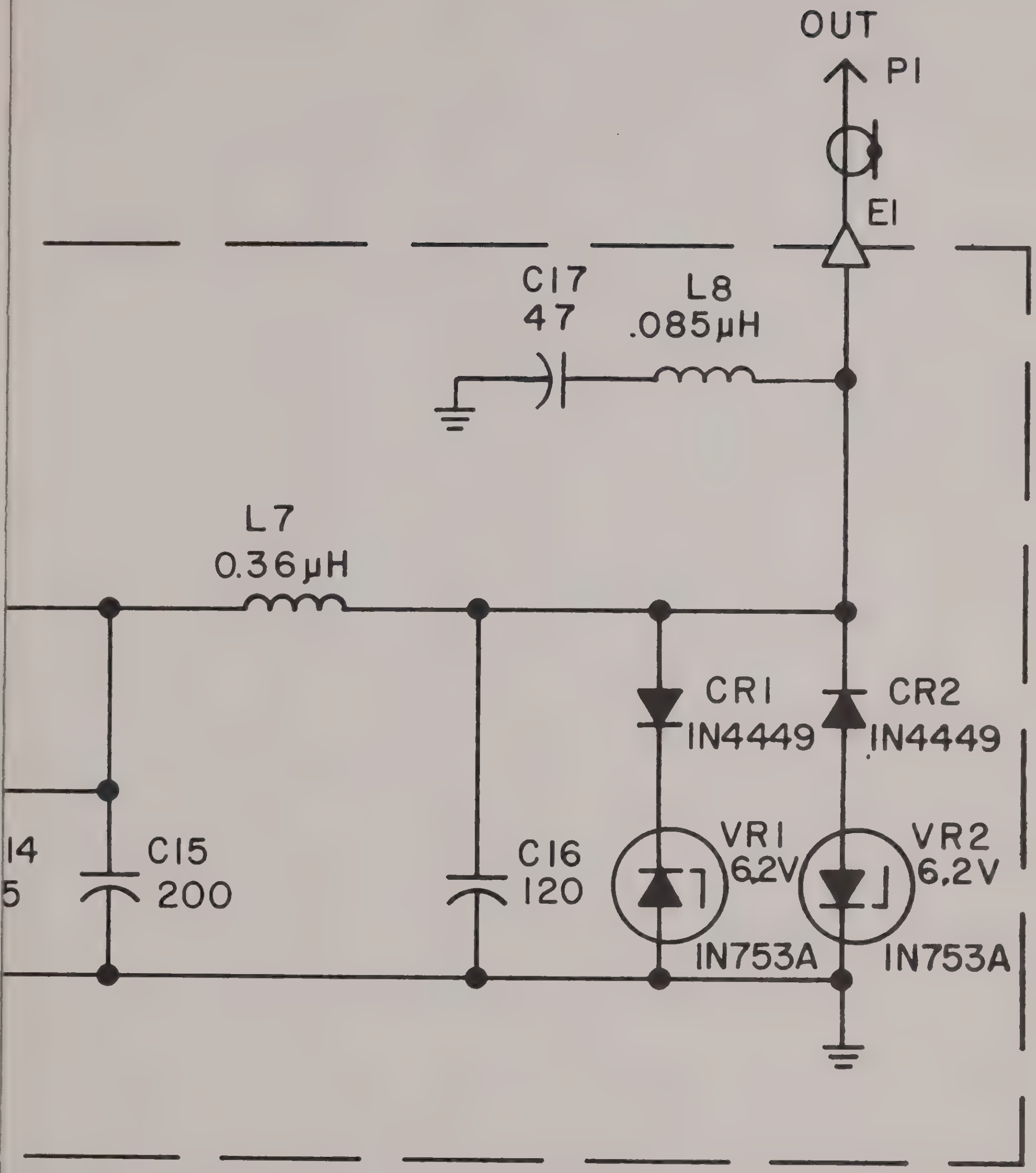
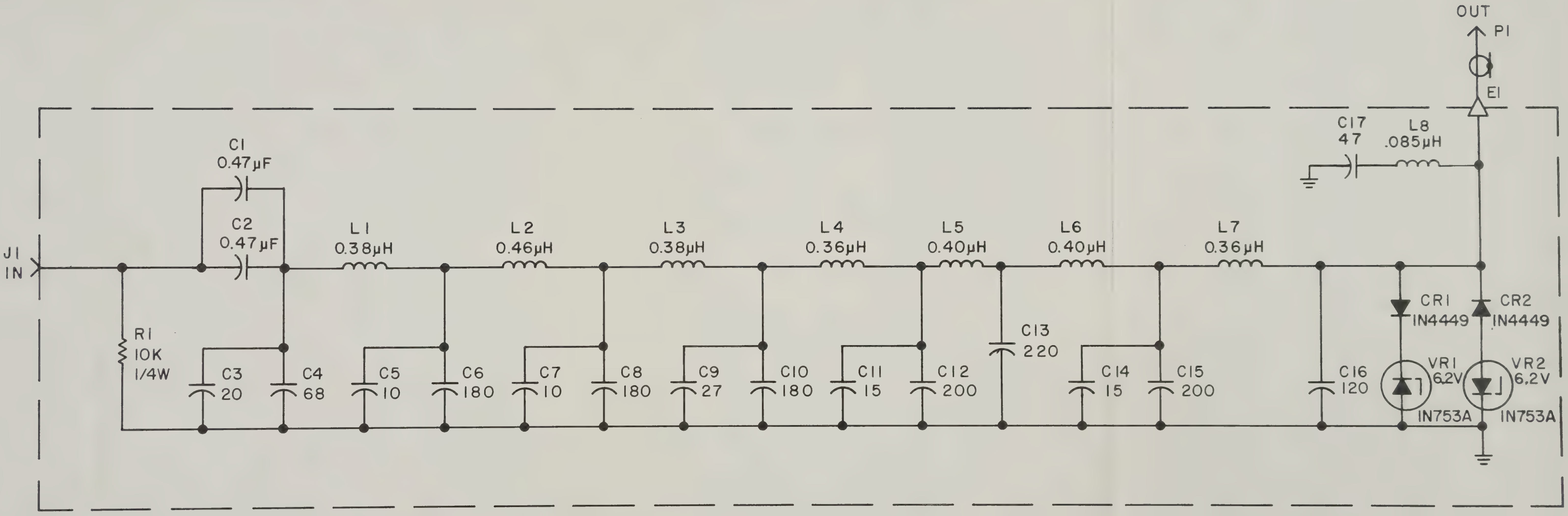
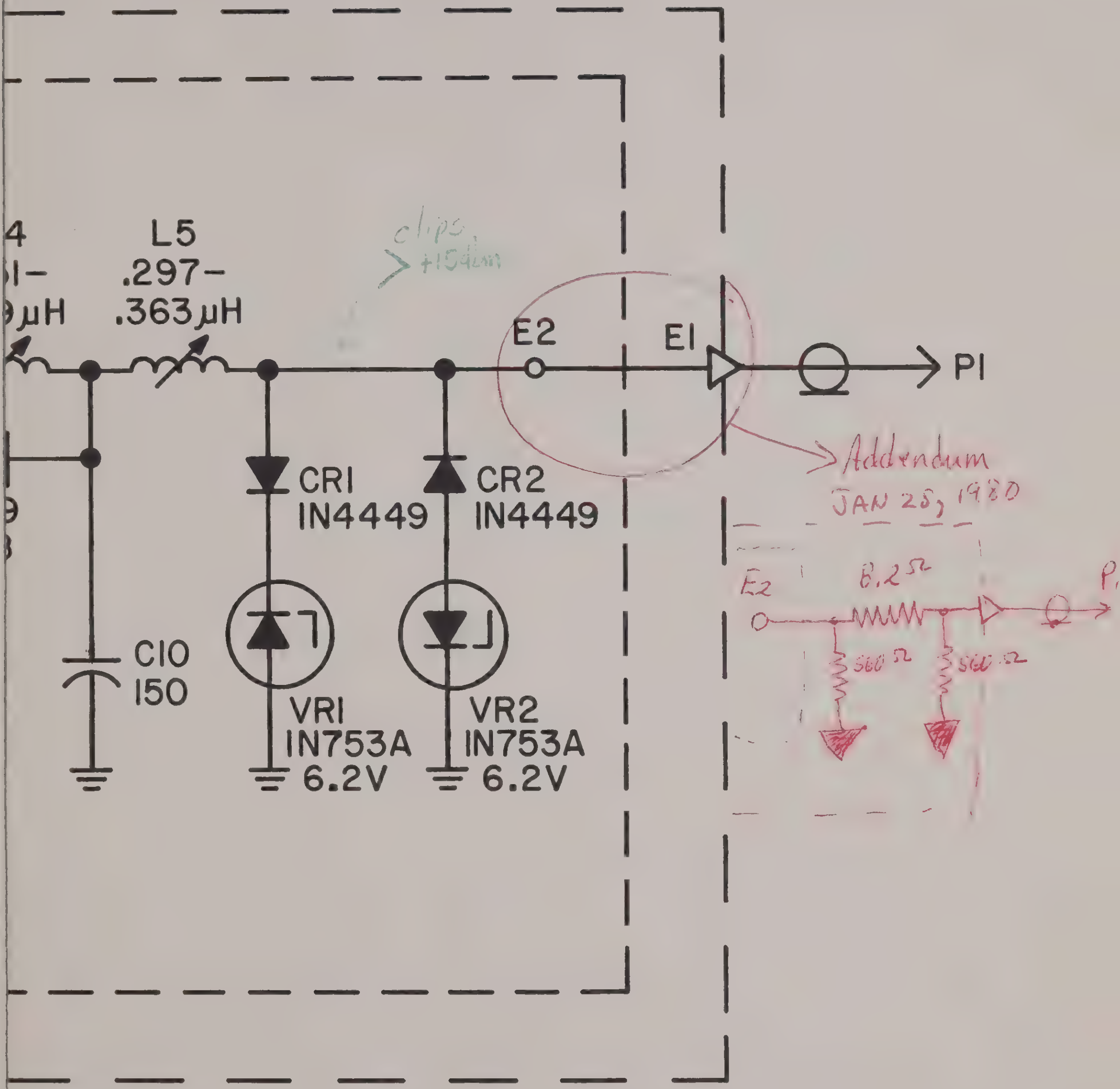


Figure 6-1. Type 791616 RF Filter (A2), Schematic Diagram 34437



NOTE : UNLESS SPECIFIED,
a) RESISTANCE IS IN OHMS.
b) CAPACITANCE IS pF

Figure 6-1. Type 791616 RF Filter (A2), Schematic Diagram 34437



clips > +15dbm

Addendum JAN 25, 1980

Figure 6-1a. Type 791616 RF Filter (A2), Schematic Diagram 380082 (Product Improvement) 6-1a

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN pF.

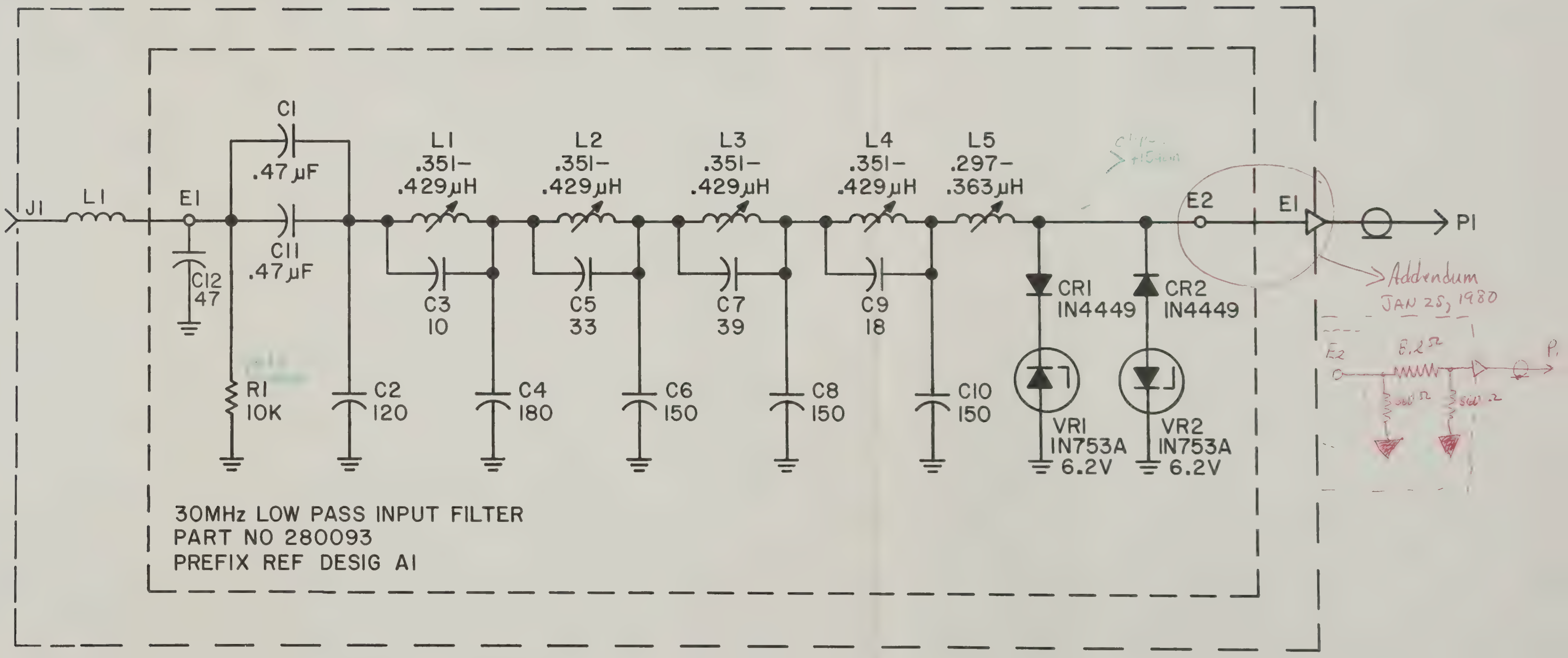


Figure 6-1a. Type 791616 RF Filter (A2), Schematic Diagram 380082 (Product Improvement) 6-1a

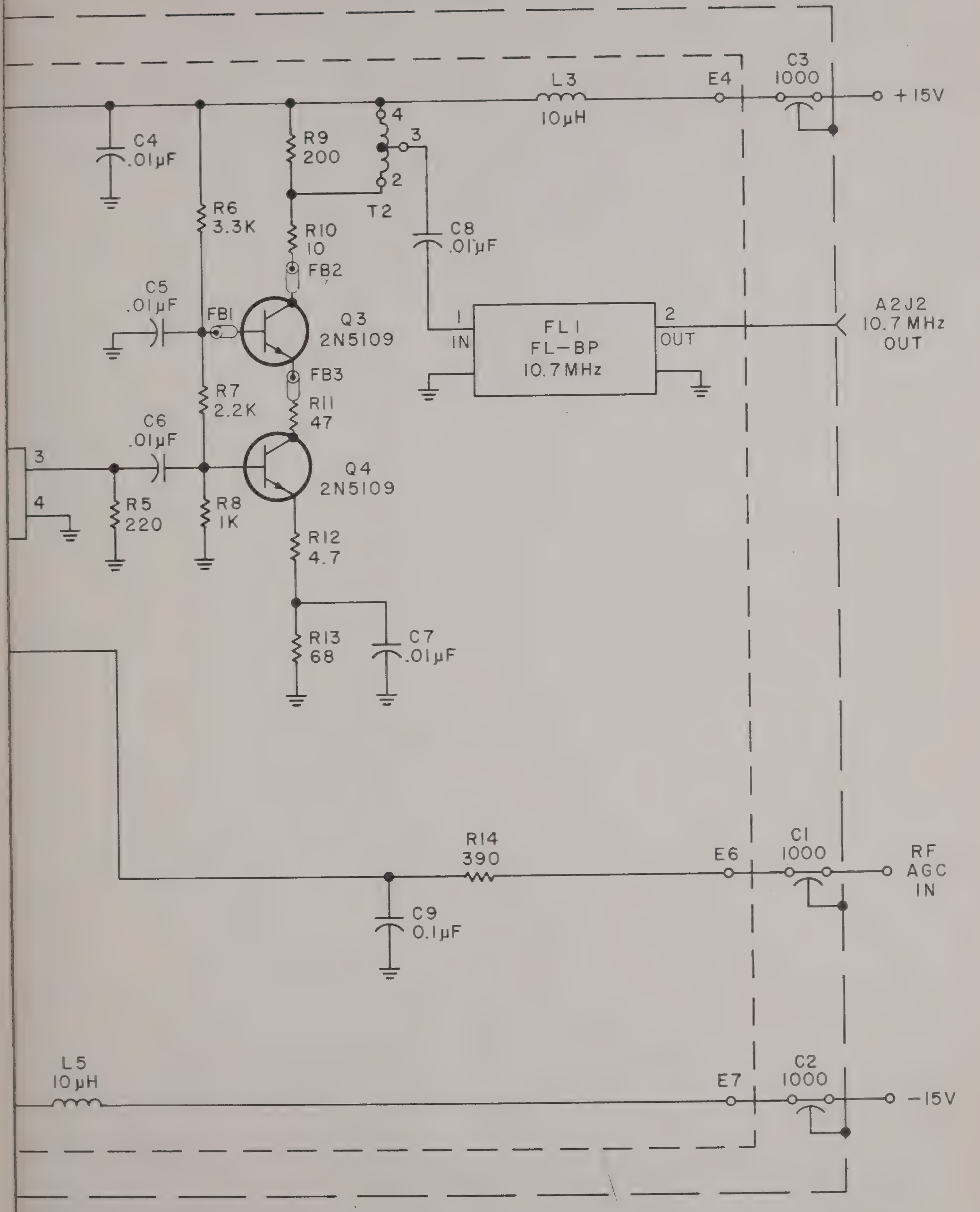
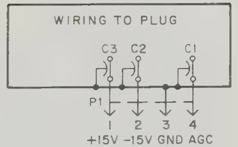


Figure 6-2. Type 791592 Input Converter (A3), Schematic Diagram 51178

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN pF.
2. NOMINAL VALUE; FINAL VALUE FACTORY SELECTED.



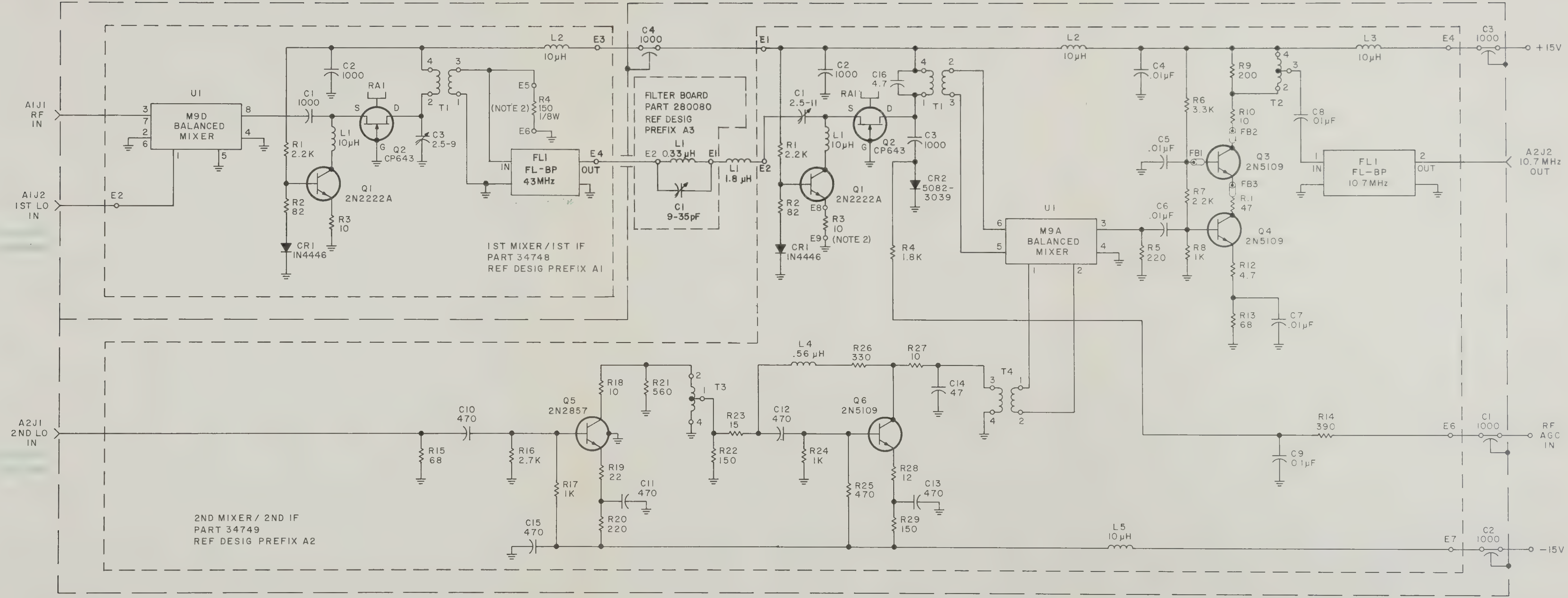
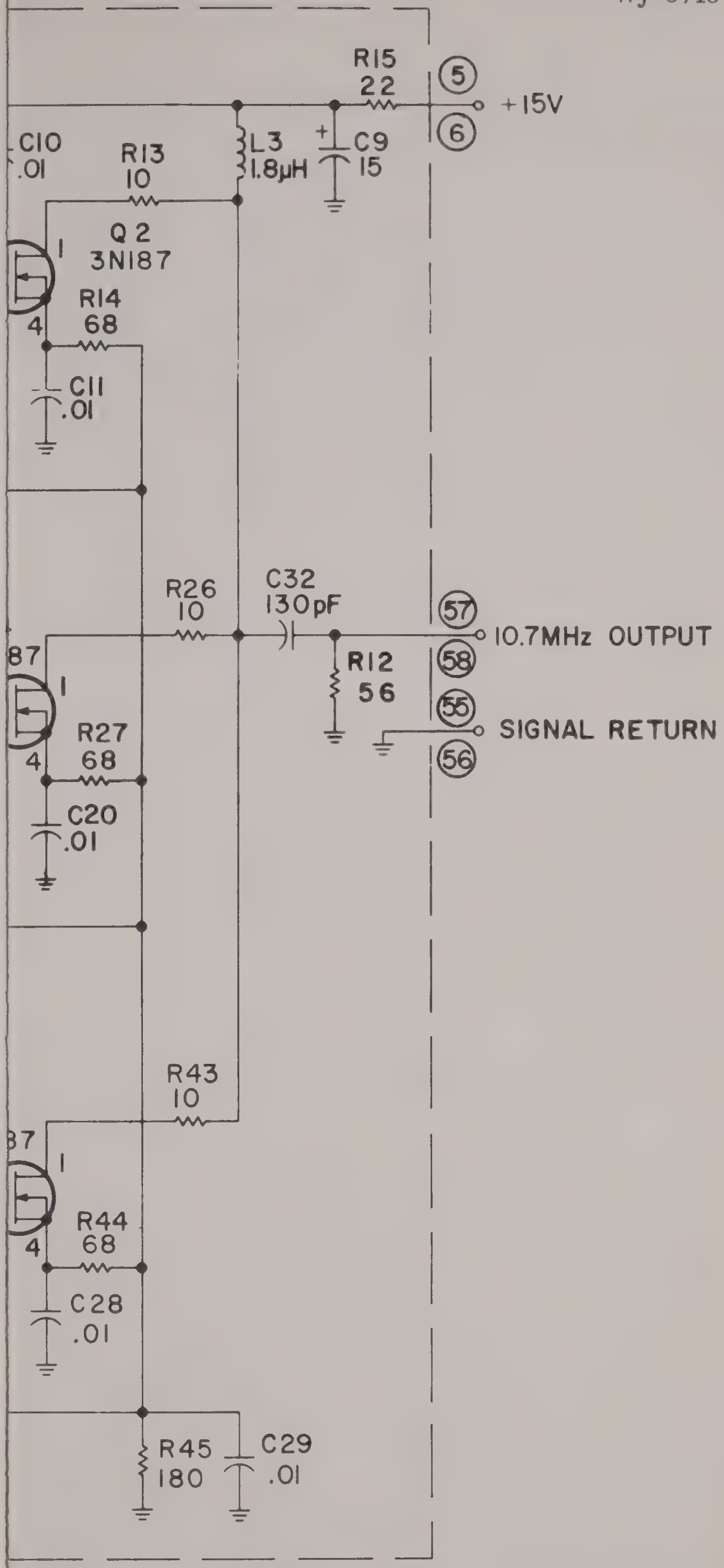
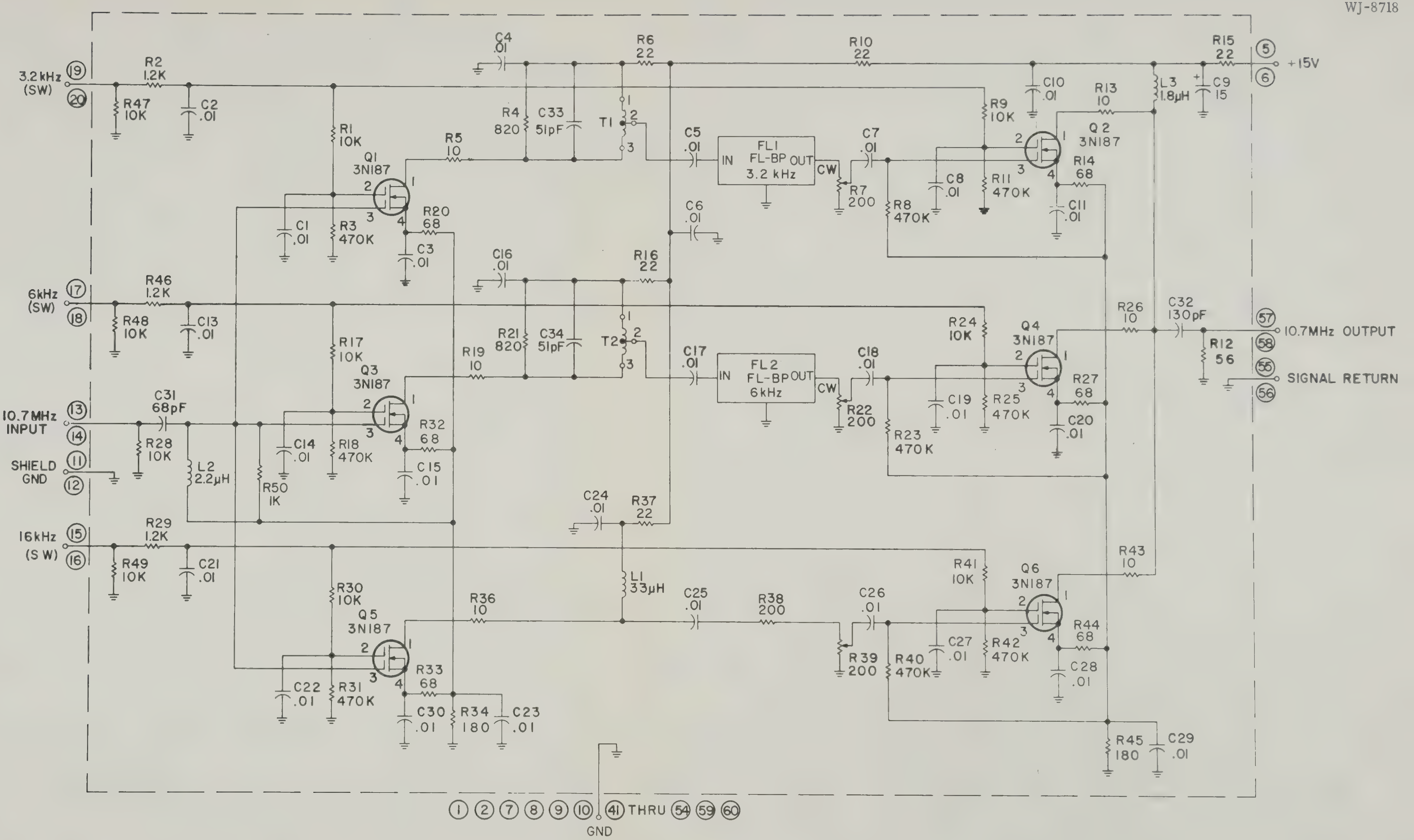


Figure 6-2. Type 791592 Input Converter (A3), Schematic Diagram 51178



6-3. Type 791594 10.7 MHz Filter Switch (A4A1), Schematic Diagram 51177



NOTES:
1. UNLESS OTHERWISE SPECIFIED.
a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
b) CAPACITANCE IS IN μF.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.

Figure 6-3. Type 791594 10.7 MHz Filter Switch (A4A1), Schematic Diagram 51177

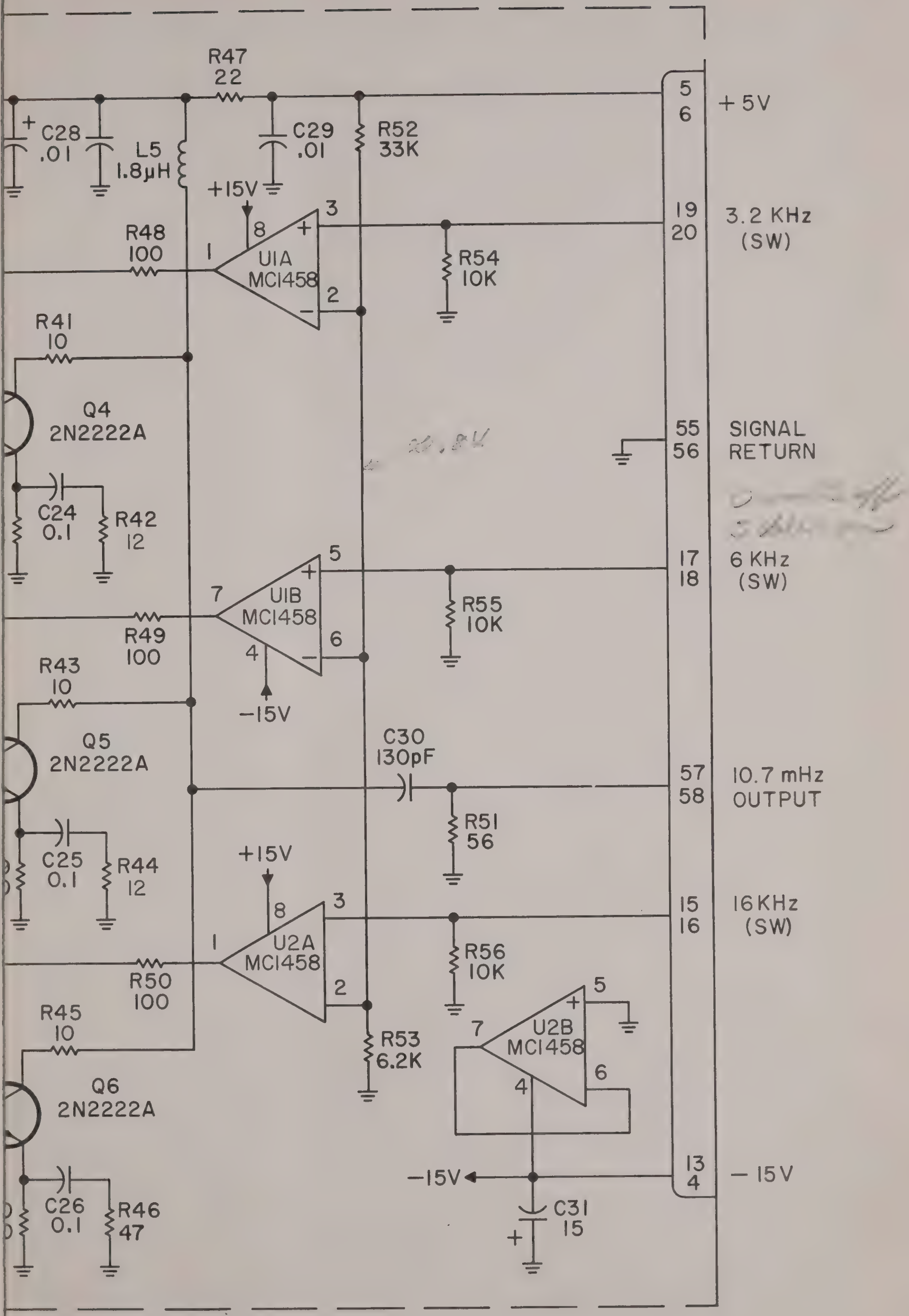
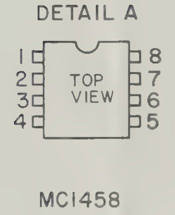


Figure 6-3a. Type 791594 10.7 MHz Filter Switch (A4A1) Schematic Diagram 480103 (Product Improvement)



NOTES

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ± 5%, 1/4W.
   b) CAPACITANCE IS IN µF.
2. PIN CONFIGURATION SHOWN IN DETAIL A.

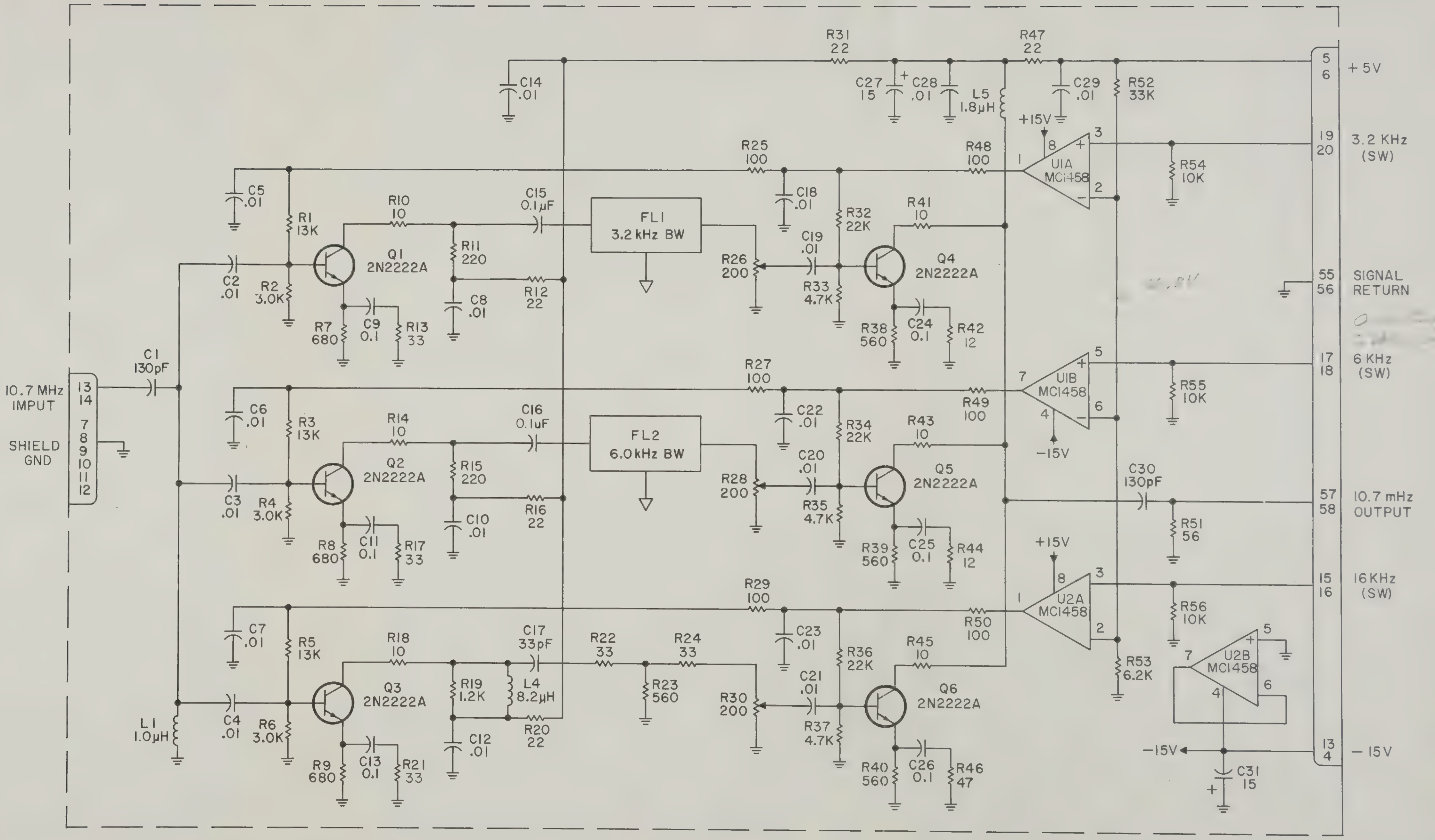
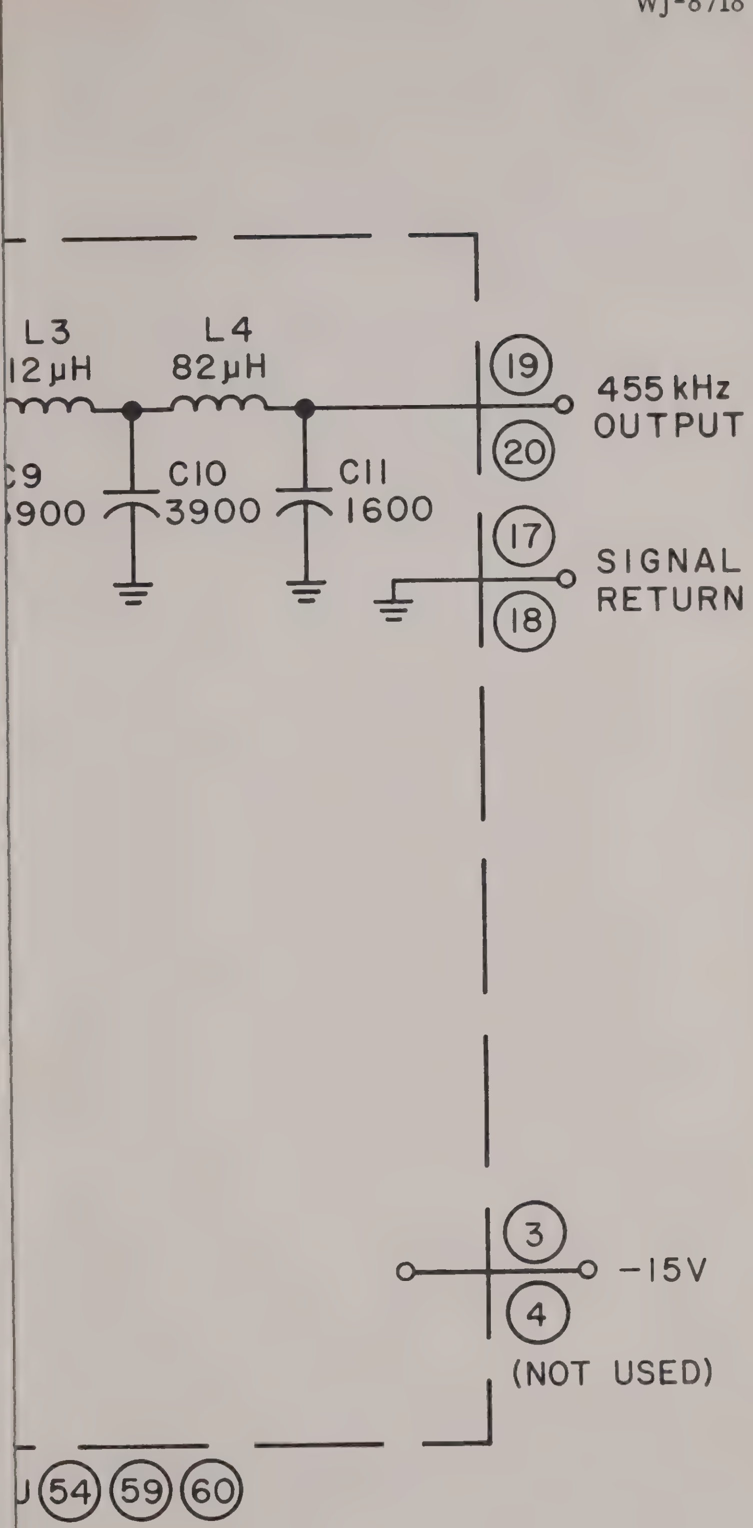
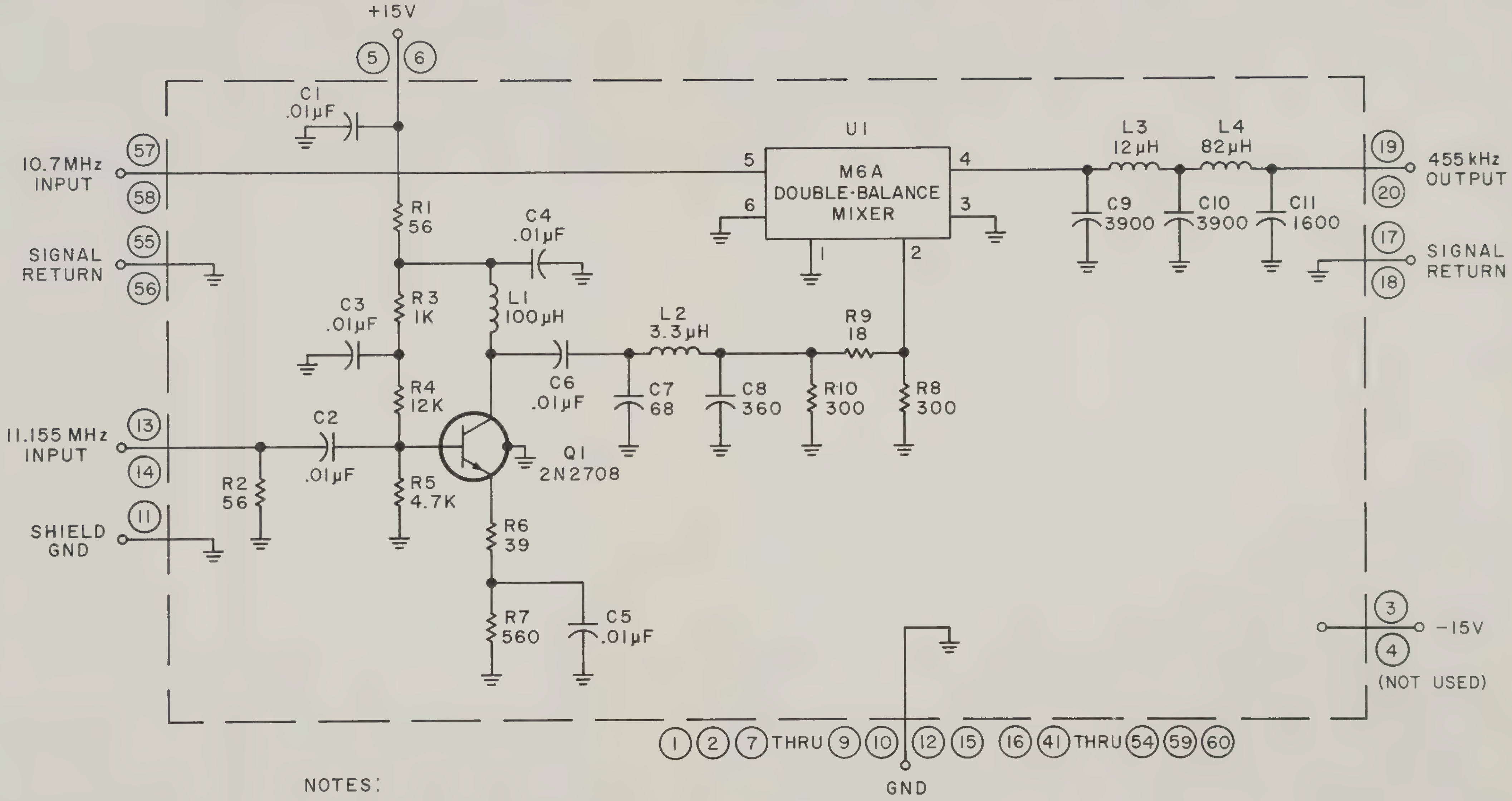


Figure 6-3a. Type 791594 10.7 MHz Filter Switch (A4A1) Schematic Diagram 480103 (Product Improvement)



. Type 71430 10.7 MHz/455 kHz Converter (A4A2), Schematic Diagram 34384



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN pF.
2. ENCIRCLED NUMBERS ARE MODULE PINS.

Figure 6-4. Type 71430 10.7 MHz/455 kHz Converter (A4A2), Schematic Diagram 34384

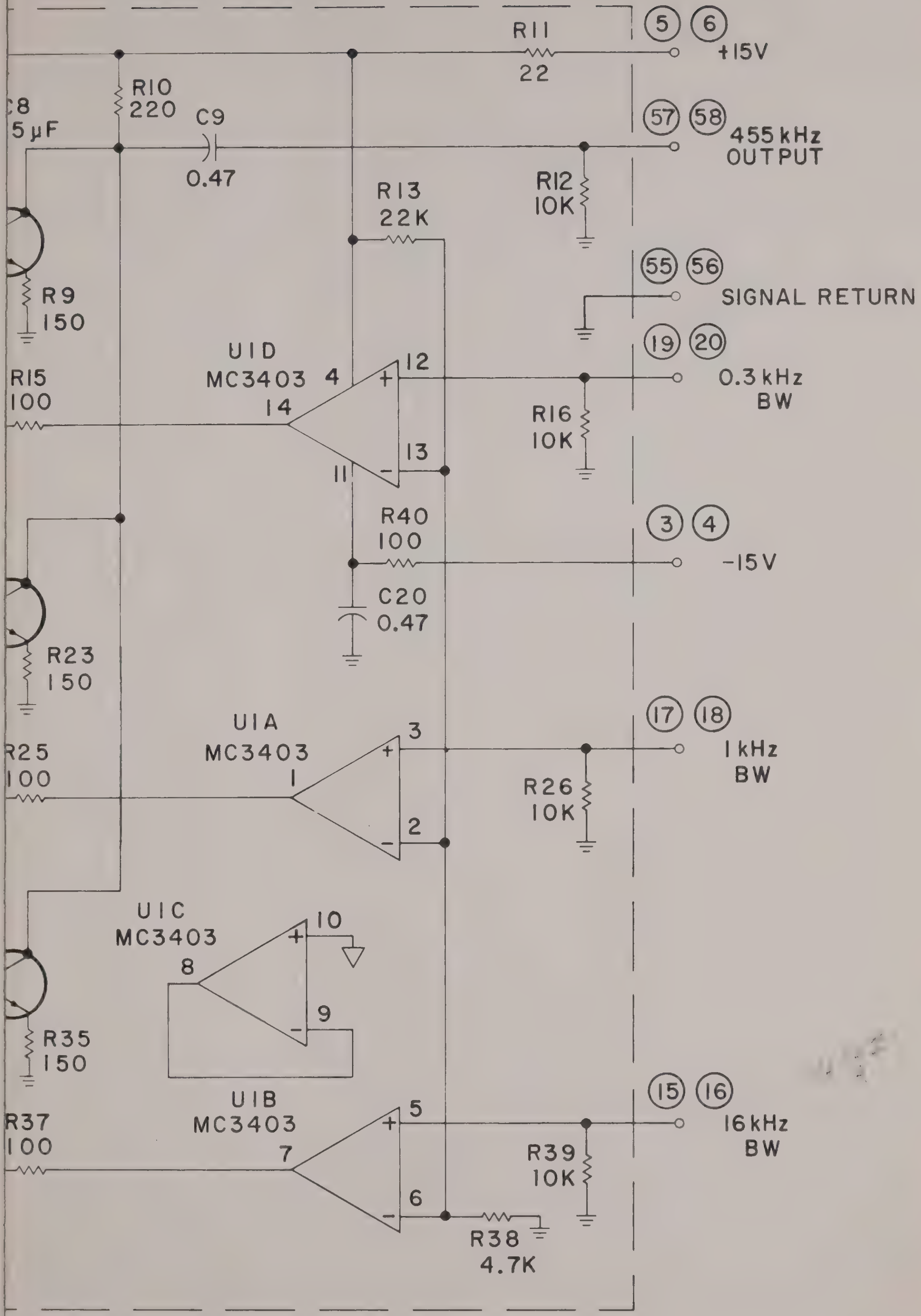
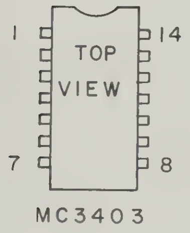


Figure 6-5. Type 791595 455 kHz Filter Switch (A4A3), Schematic Diagram 43561

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS +5%, 1/4 W.
   b) CAPACITANCE IS IN µF.
2. ENCIRCLED NUMBERS ARE MODULE PINS.
3. DIFFERENCE BETWEEN TYPES IS SHOWN IN TABLE A.
4. IF DIFFICULTY OF PROCUREMENT EXISTS FOR PART MC3403P PART LM348N MAY BE USED AS ALTERNATE IN THIS APPLICATION.



TYPE	FL1
791595-1	325Hz BPF
791595-2	100Hz BPF

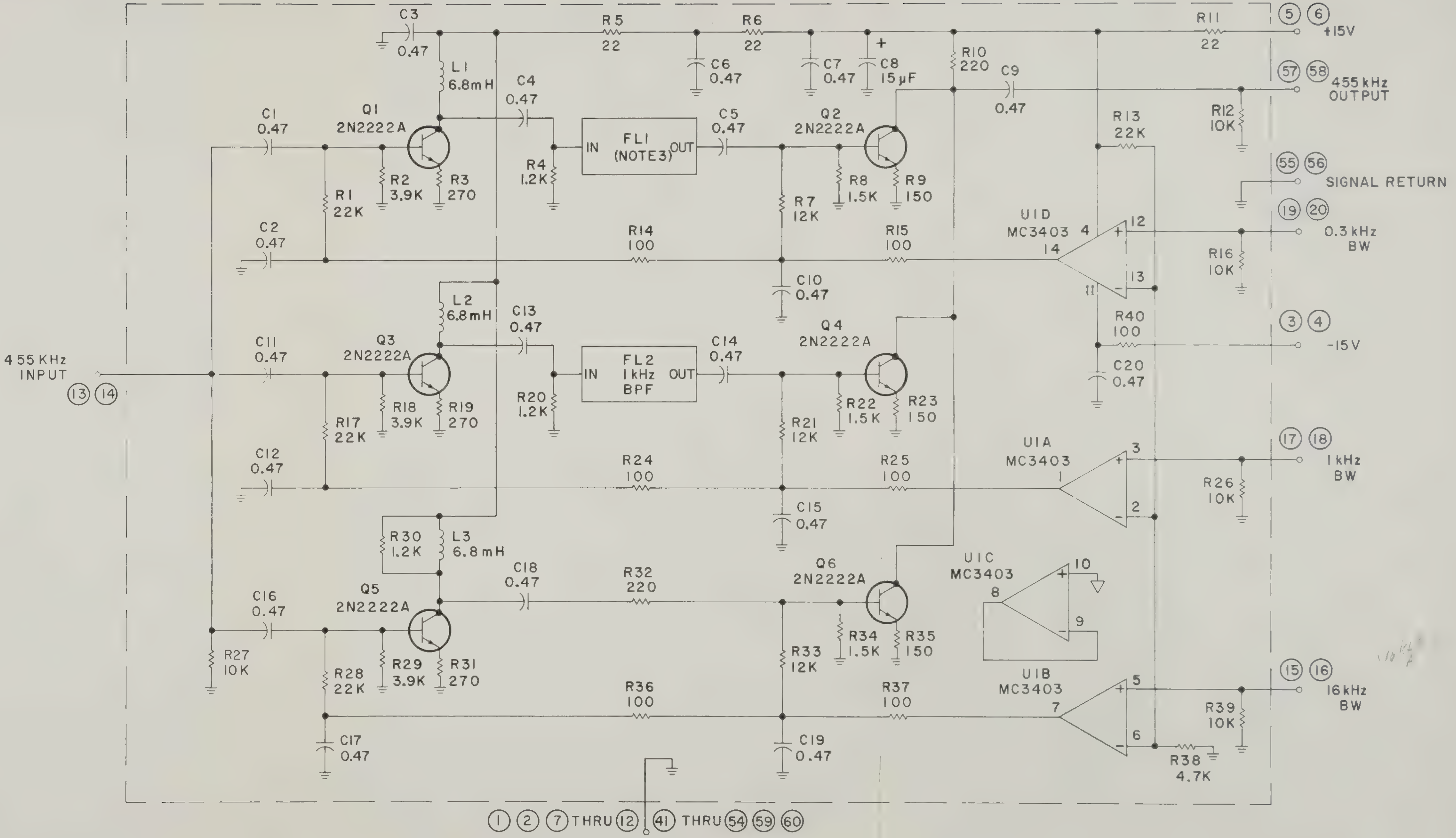


Figure 6-5. Type 791595 455 kHz Filter Switch (A4A3), Schematic Diagram 43561

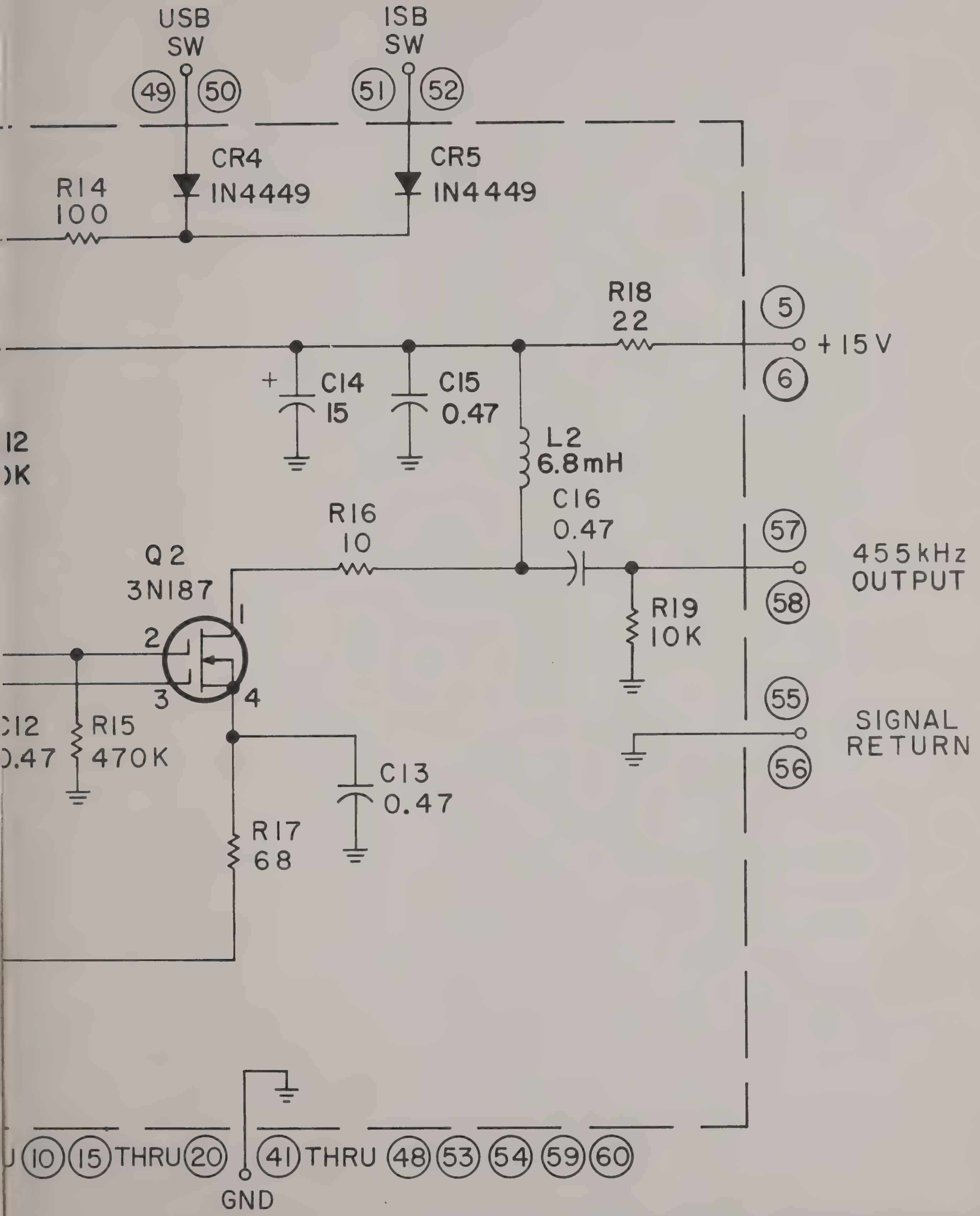


Figure 6-6. Type 791596 USB Filter Switch Option (A4A4), Schematic Diagram 43196

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN µF.
2. ENCIRCLED NUMBERS (LETTERS) ARE MODULE PIN NUMBERS.

HIGHEST REF DESIG USED	REF DESIG NOTE USED
C16	
CR5	
FL1	
L2	
Q2	
R22	

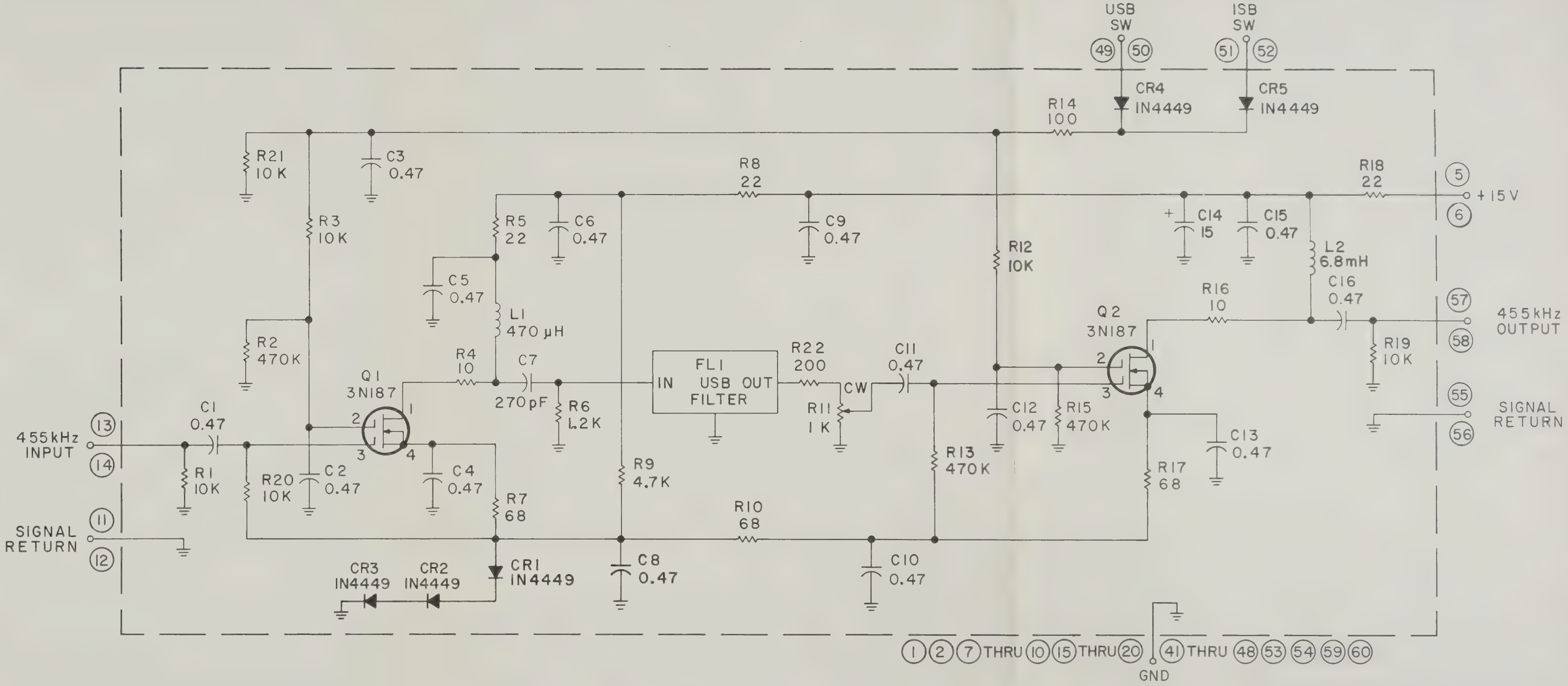


Figure 6-6. Type 791596 USB Filter Switch Option (A4A4), Schematic Diagram 43196

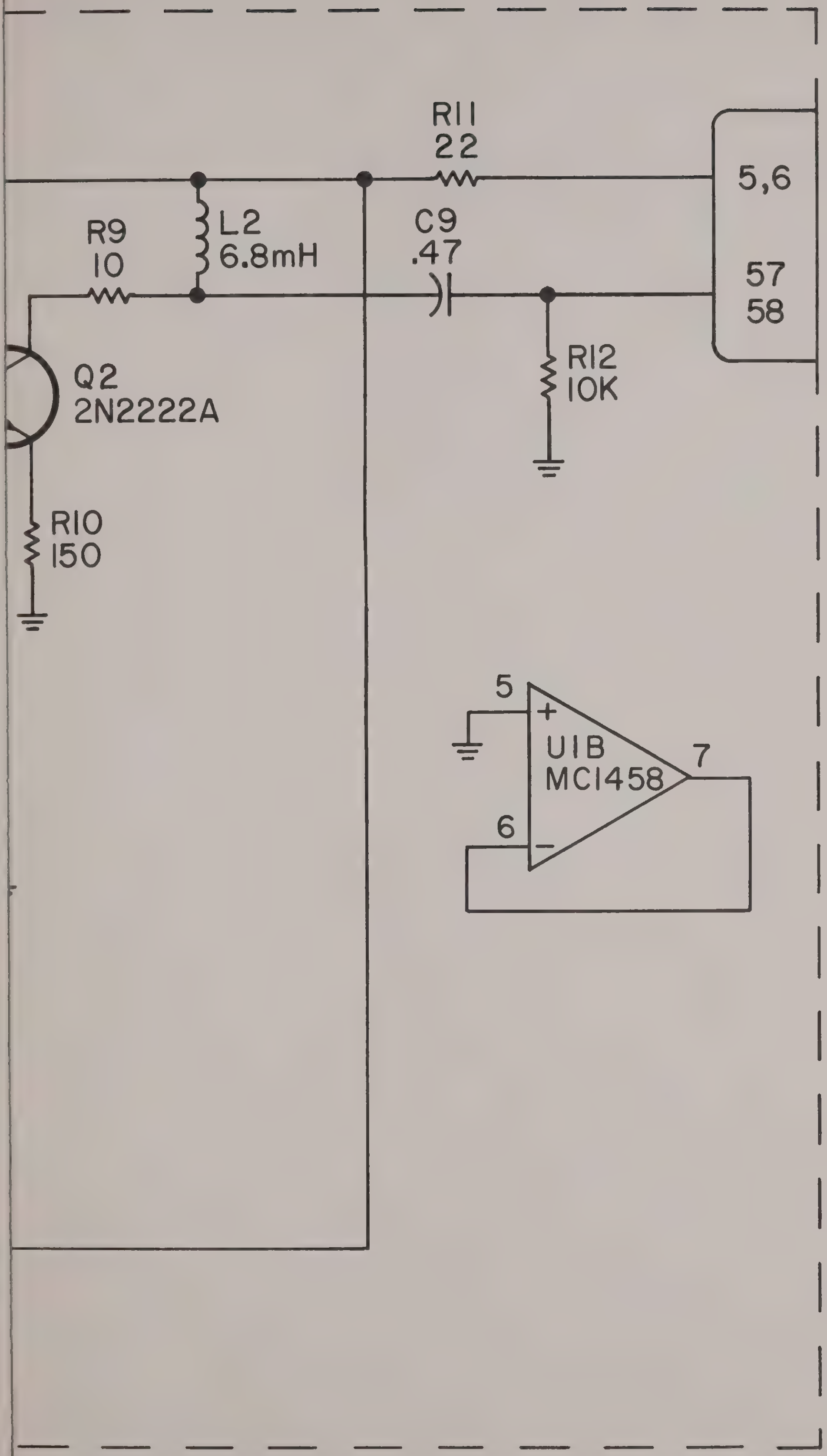


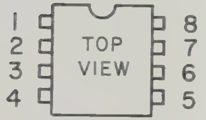
Figure 6-6a. Type 791596 USB Filter Switch Option (A4A4)
Schematic Diagram 480102
(Product Improvement)

☆ see addendum Jan 25 '80

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ± 5%, 1/4W.
   b) CAPACITANCE IS IN µF.
2. PIN CONFIGURATION IS SHOWN IN DETAIL A
3. DIFFERENCE BETWEEN TYPES IS SHOWN IN TABLE A

DETAIL A



MC1458

TABLE A

TYPE	FL1
791596-1	92122
791596-2	92194

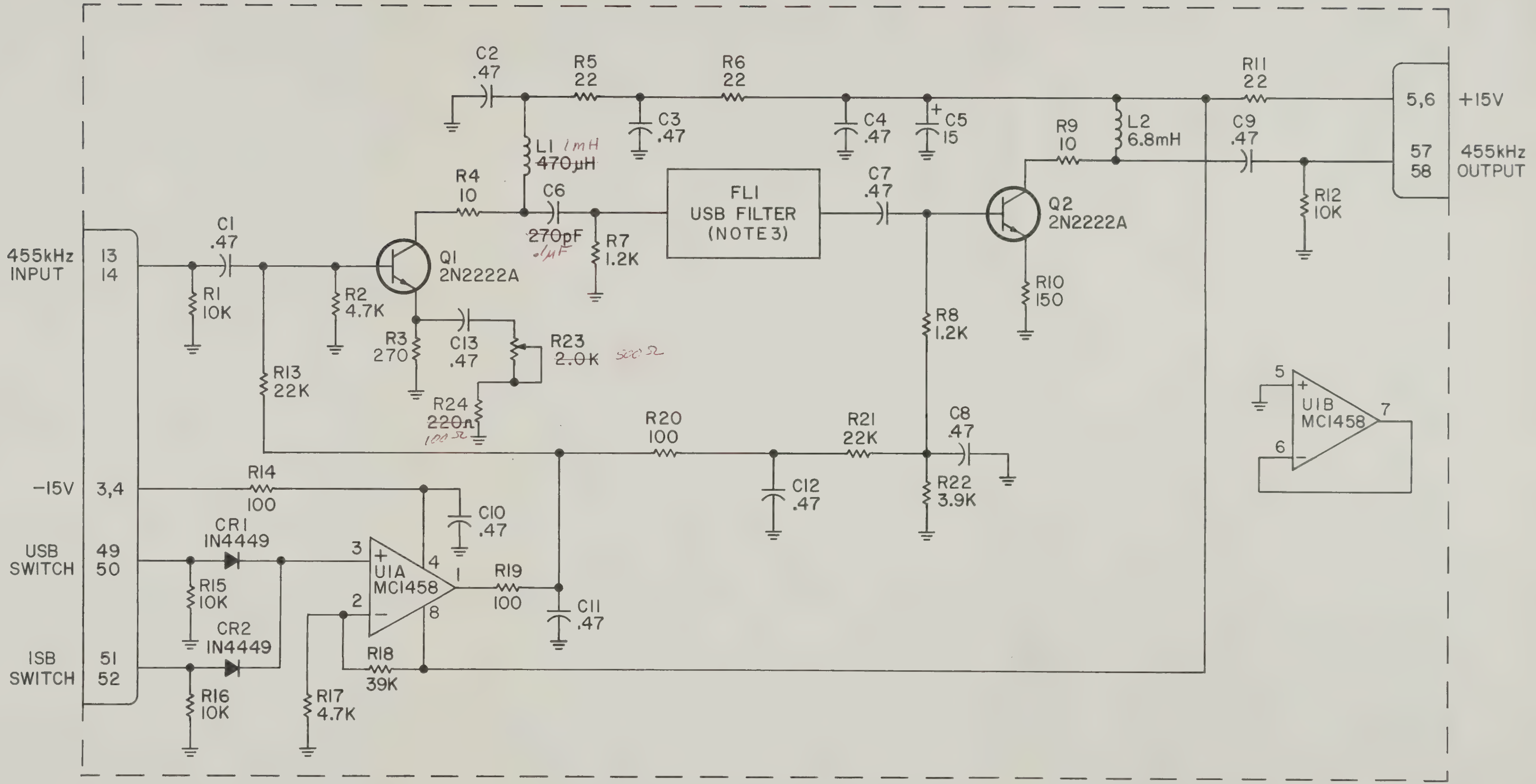


Figure 6-6a. Type 791596 USB Filter Switch Option (A4A4)
Schematic Diagram 480102
(Product Improvement)

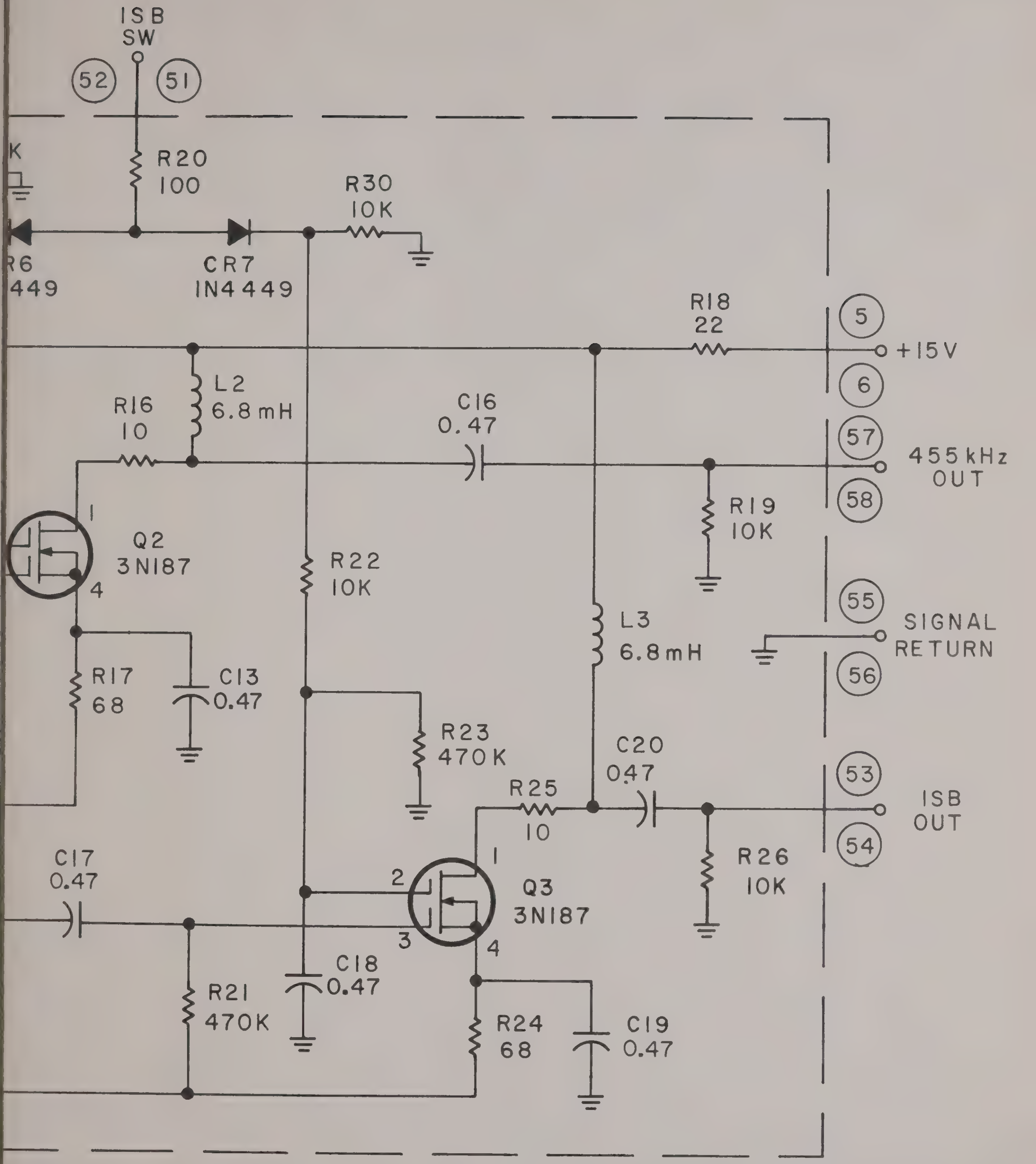


Figure 6-7. Type 791597 ISB/LSB Filter Switch Option (A4A5), Schematic Diagram 43249

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS IN OHMS, ± 5%, 1/4W
b) CAPACITANCE IS IN μF.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.

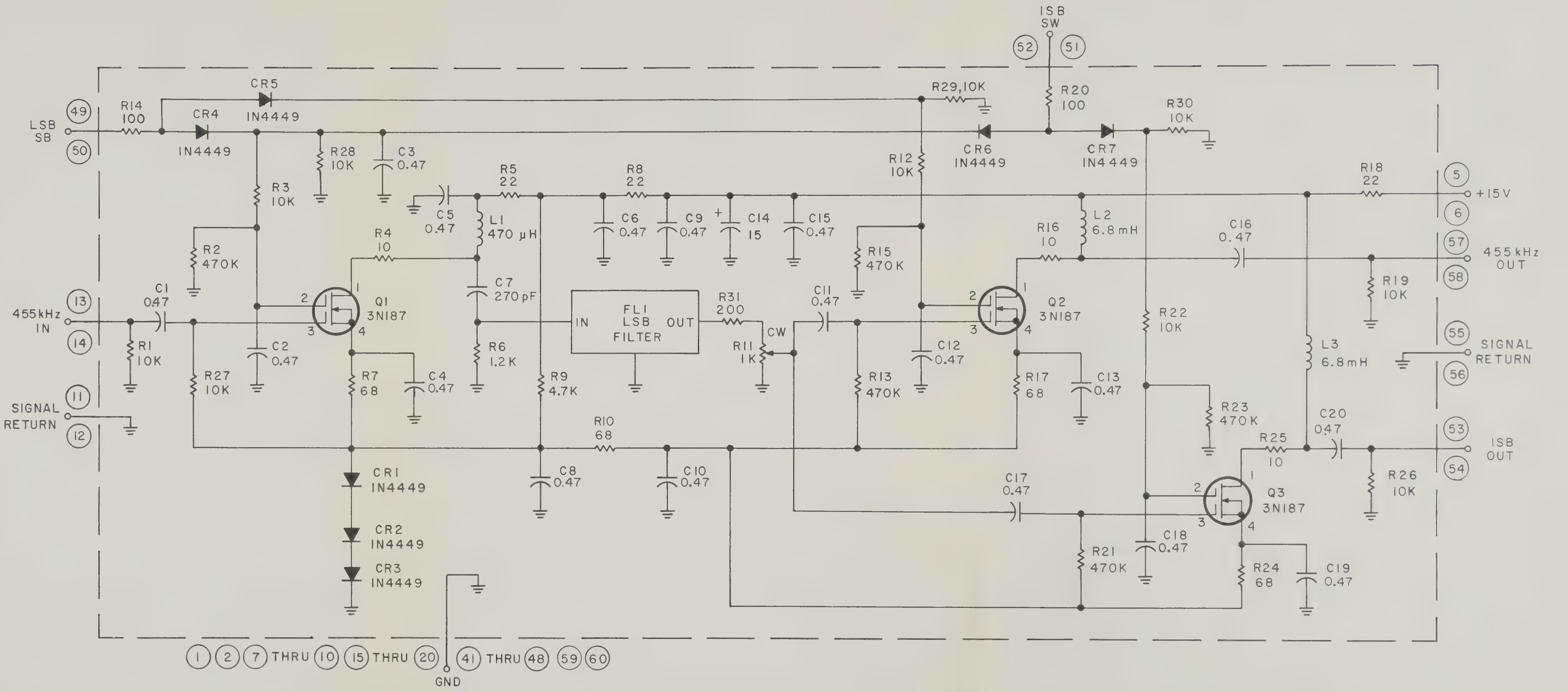


Figure 6-7. Type 791597 ISB/LSB Filter Switch Option (A4A5), Schematic Diagram 43249

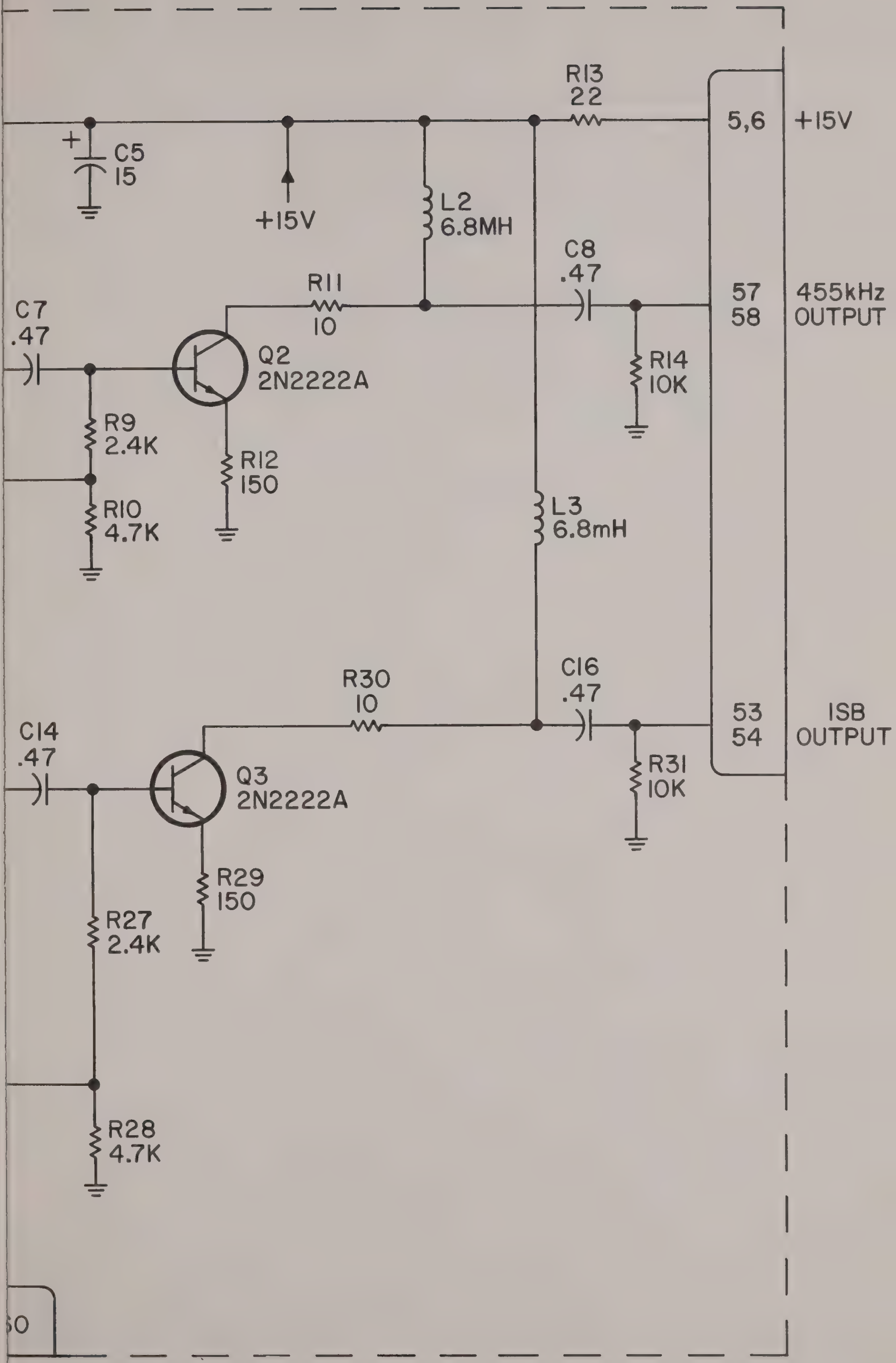


Figure 6-7a. Type 791597 ISB/LSB Filter Switch Option (A4A
Schematic Diagram 480105
(Product Improvement)

☆ See addendum - Jan 25 '80

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN µF.
2. PIN CONFIGURATION IS SHOWN IN DETAIL A.
3. DIFFERENCE BETWEEN TYPES IS SHOWN IN TABLE A

DETAIL A

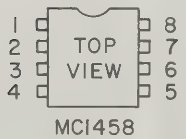


TABLE A

TYPE	FL1
791597-1	92121
791597-2	~~92195~~

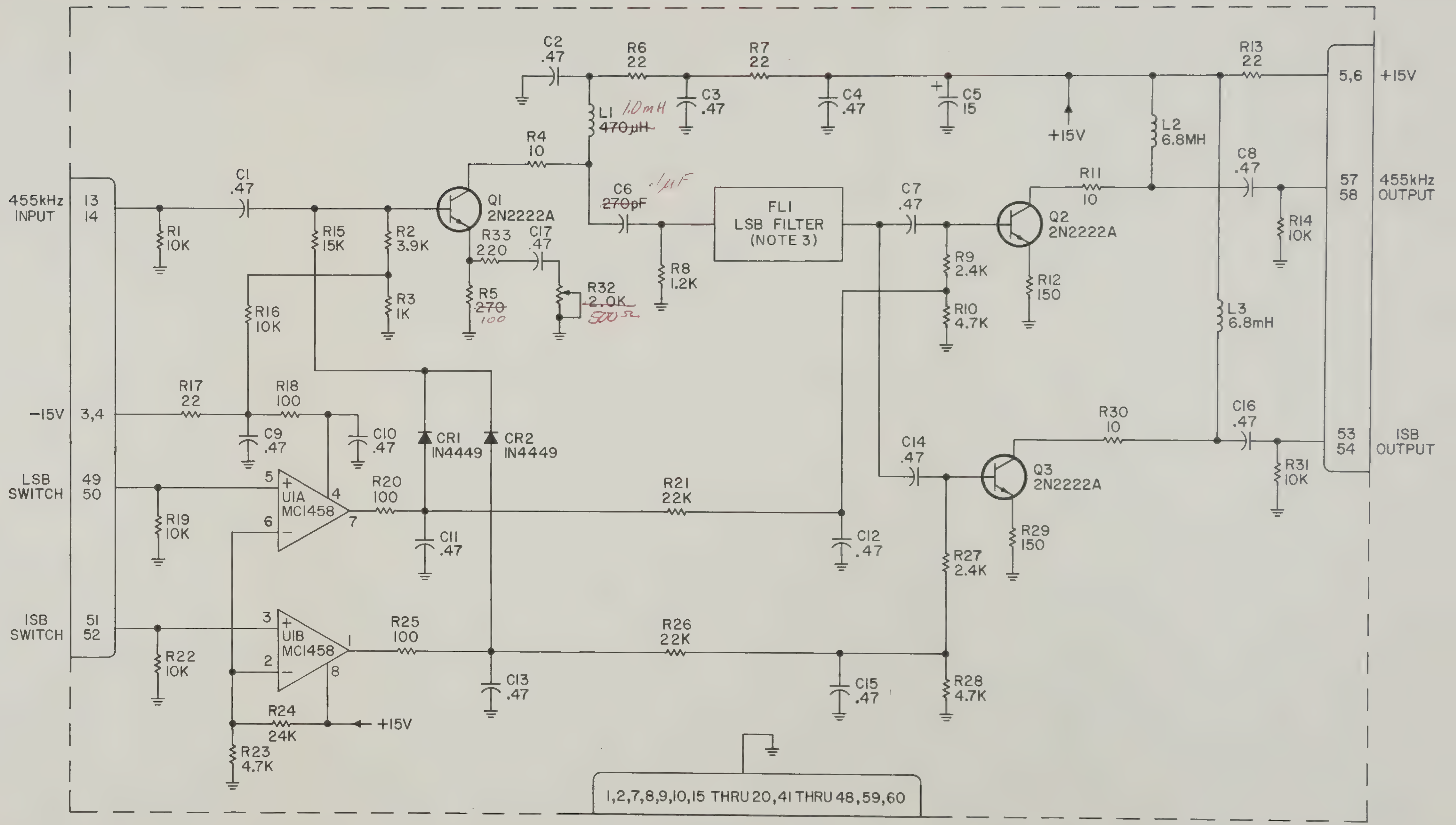


Figure 6-7a. Type 791597 ISB/LSB Filter Switch Option (A4A5) Schematic Diagram 480105 (Product Improvement)

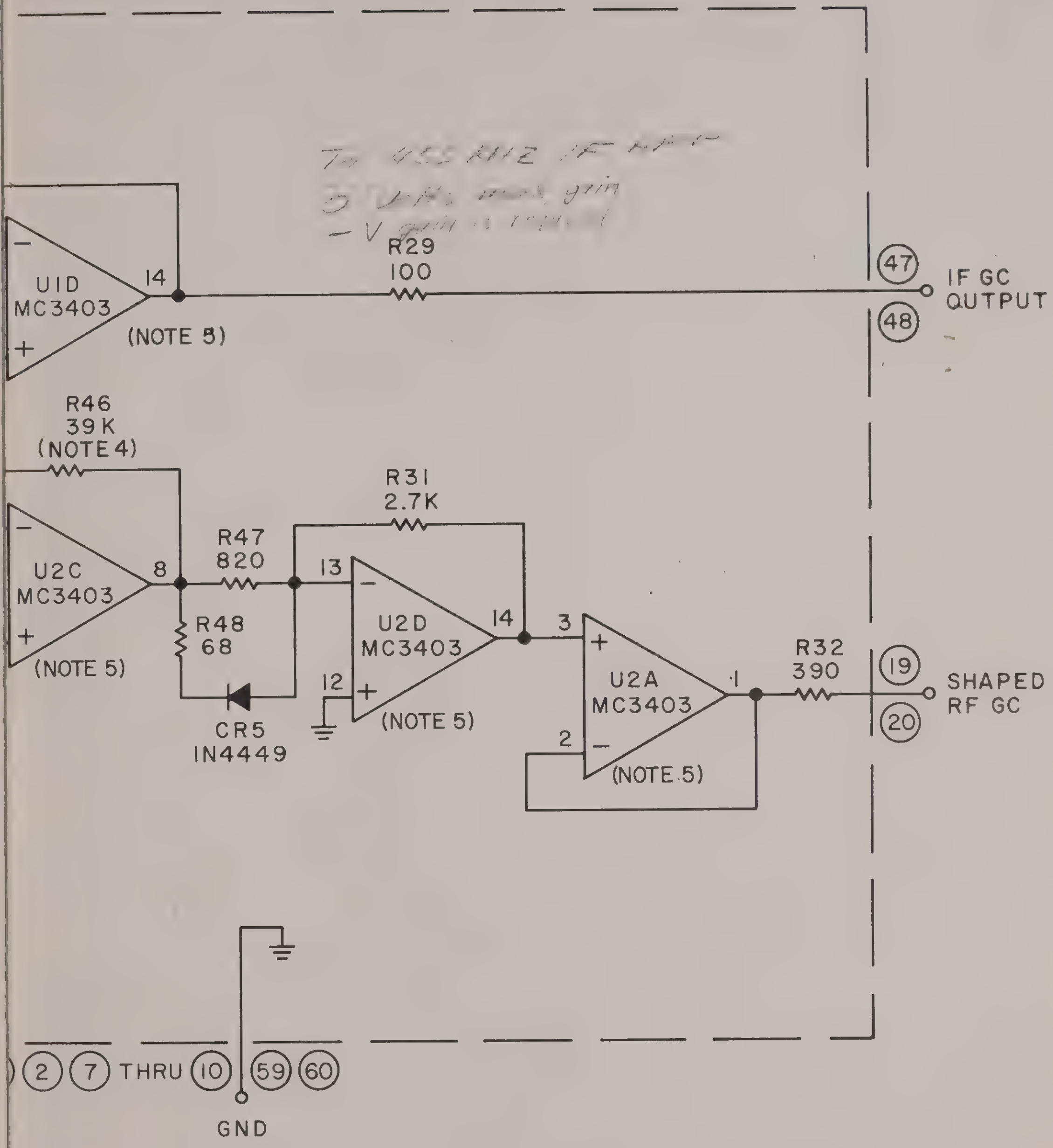
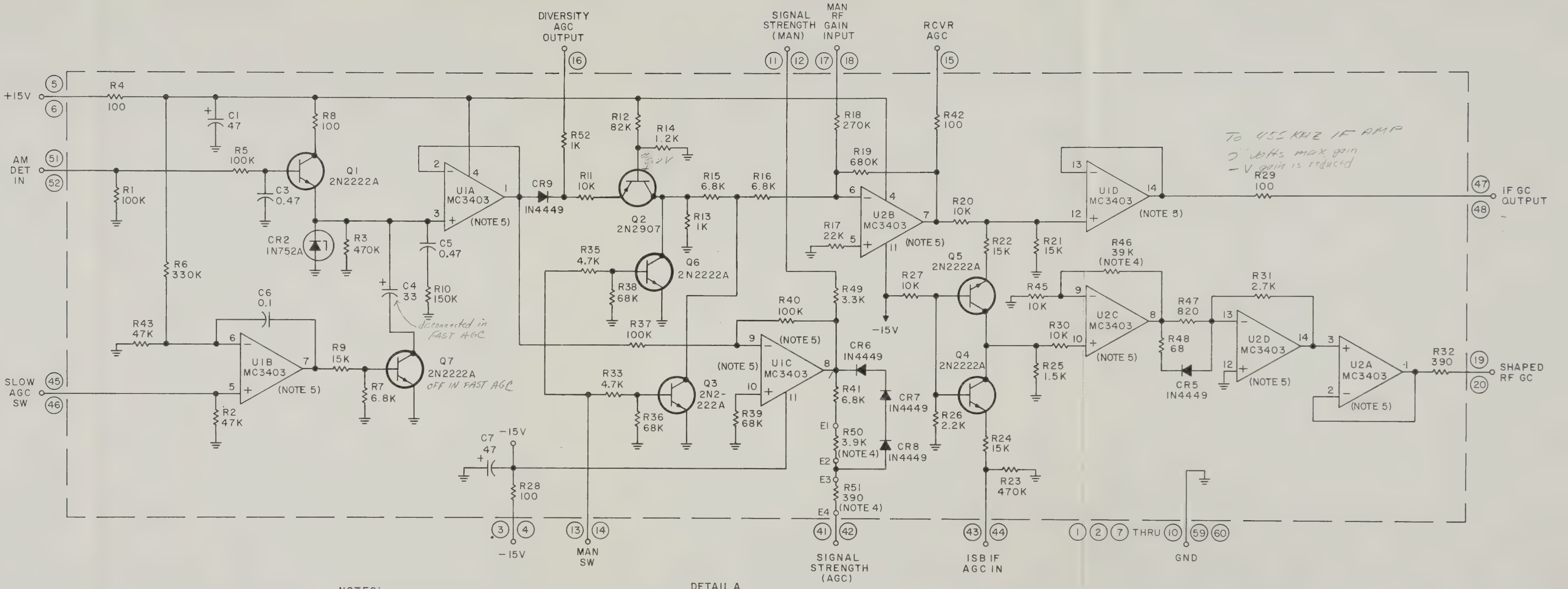


Figure 6-8. Type 78112 AGC (A4A6),
Schematic Diagram 43229



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ± 5%, 1/4W.
   b) CAPACITANCE IS IN µF.
2. ENCIRCLED NUMBERS ARE MODULE PINS.
3. U1, U2 LEAD ARRANGEMENT – DETAIL A.
4. NOMINAL VALUE; FINAL VALUE FACTORY SELECTED.
5. LM348N MAY BE USED AS AN ALTERNATIVE FOR MC3403 (SHOULD A DIFFICULTY IN PROCURING MC3403 ARISE) AT U1 AND U2 IN THIS APPLICATION.

DETAIL A

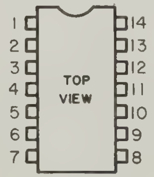


Figure 6-8. Type 78112 AGC (A4A6), Schematic Diagram 43229

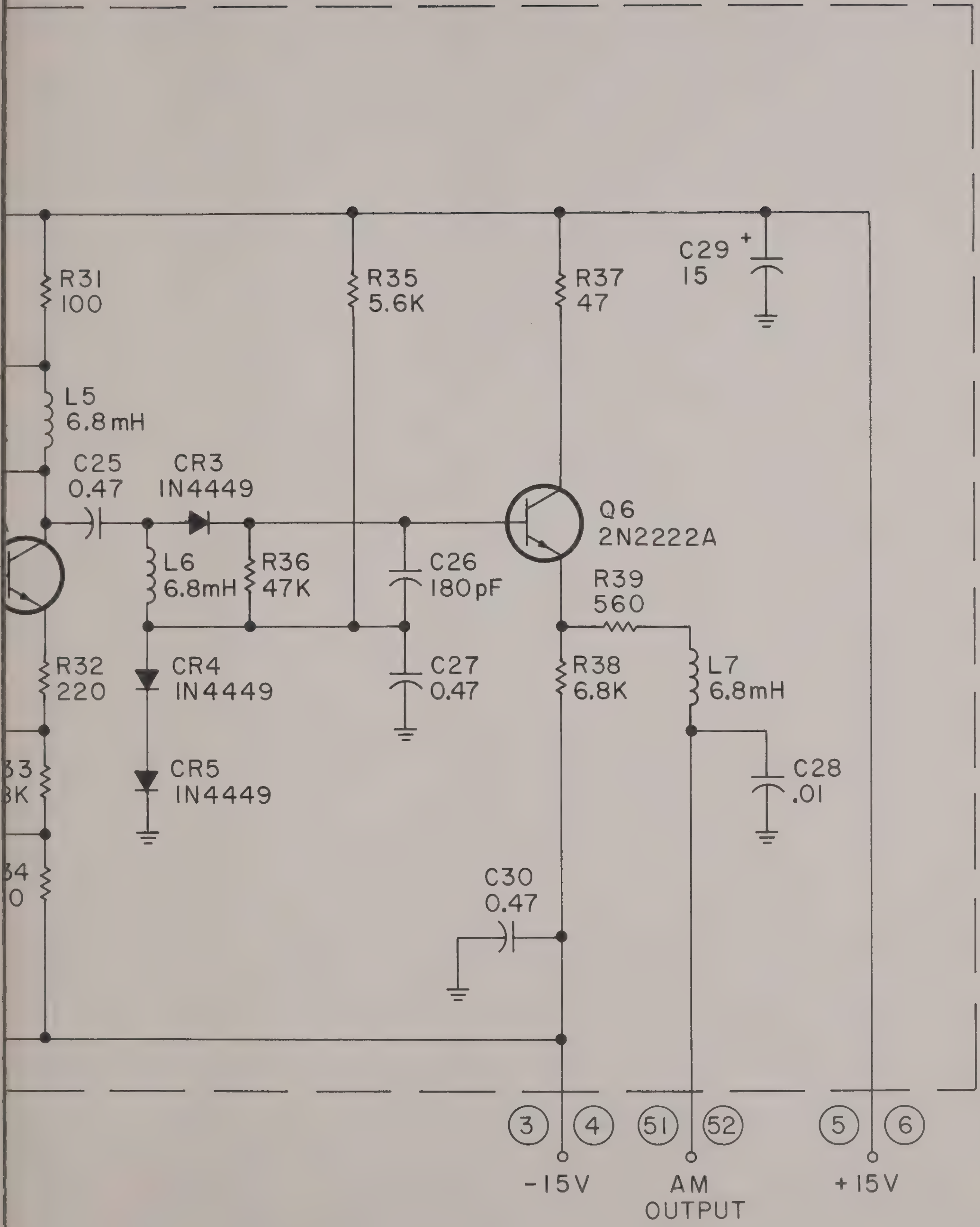


Figure 6-9. Type 72488 455kHz Amplifier/AM Detector (A4A7), Schematic Diagram 51168

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS µF.
2. ENCIRCLED NUMBERS (LETTERS) ARE MODULE PIN NUMBERS.
3. CW ON R7 INDICATES FULL CLOCKWISE POSITION OF ACTUATOR.

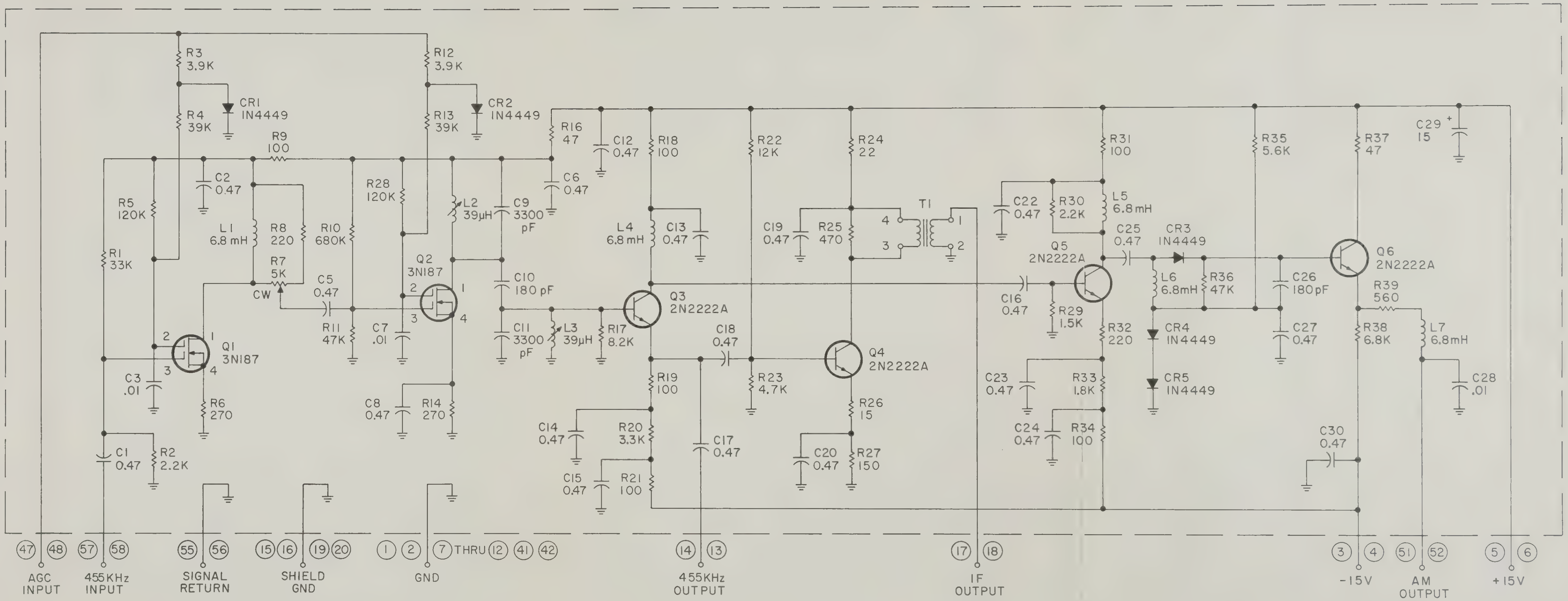
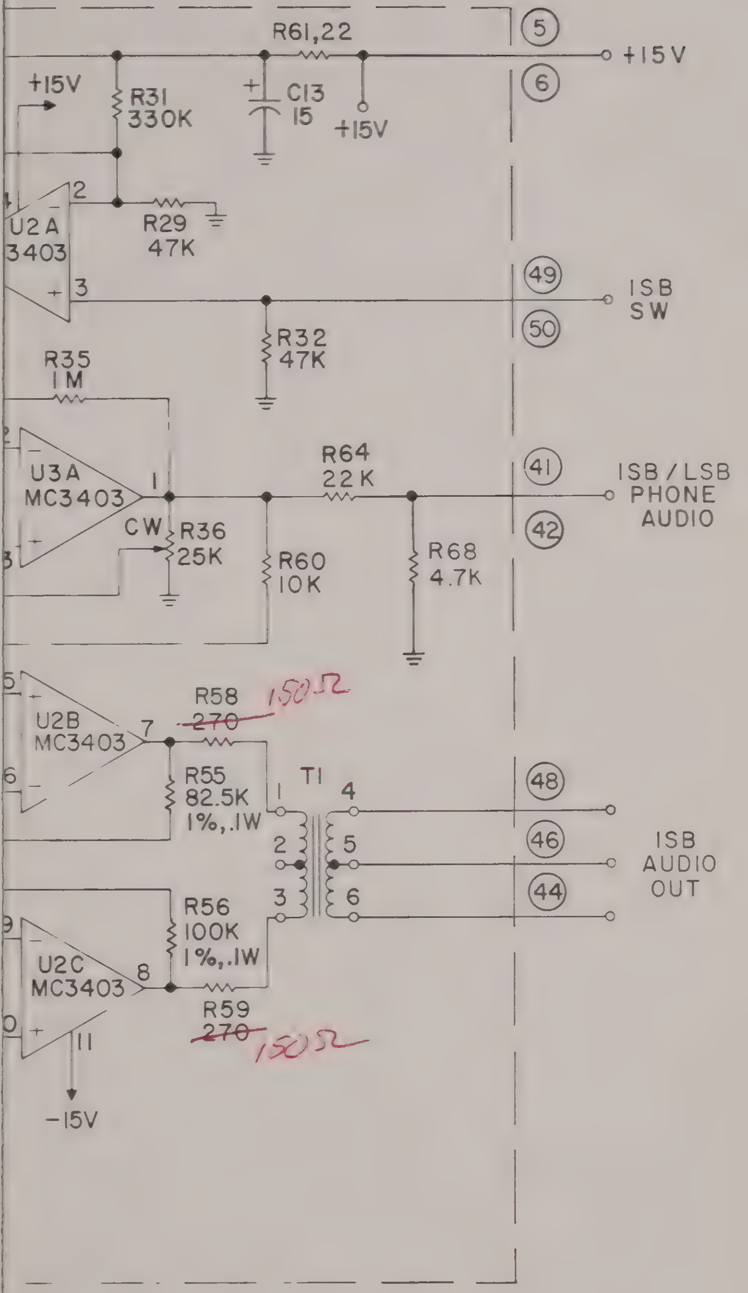
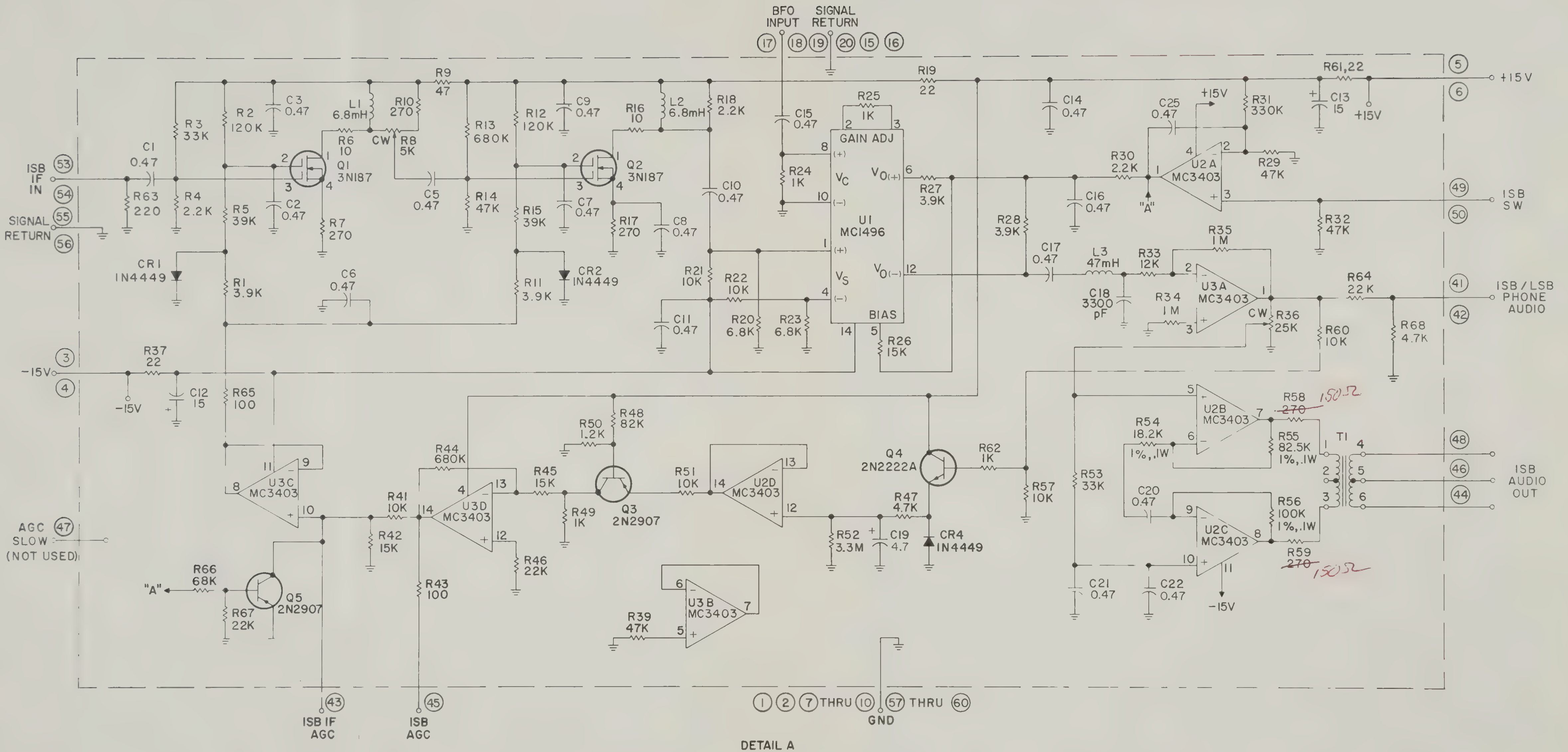


Figure 6-9. Type 72488 455kHz Amplifier/AM Detector (A4A7), Schematic Diagram 51168



ure 6-10. Type 791598 ISB Detector/Audio (A4A8), Schematic Diagram 43231

See Addendum
Jan 25, 1980



NOTES
1 UNLESS OTHERWISE SPECIFIED:
a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
b) CAPACITANCE IS IN µF
2. ENCIRCLED NUMBERS ARE MODULE PINS.
3 U1,U2,U3 LEAD ARRANGEMENT-DETAIL A

DETAIL A

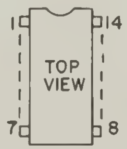


Figure 6-10. Type 791598 ISB Detector/Audio (A4A8), Schematic Diagram 43231

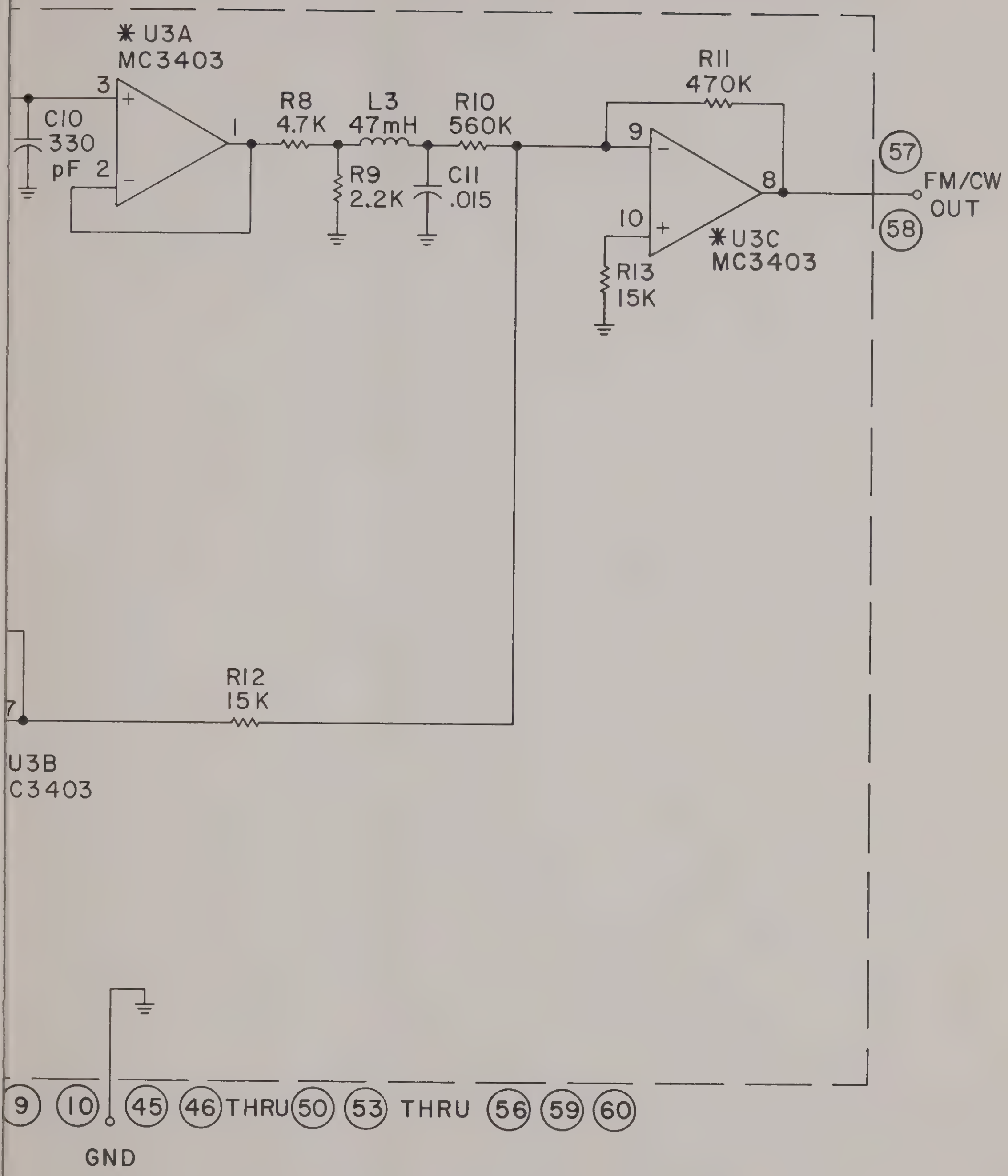
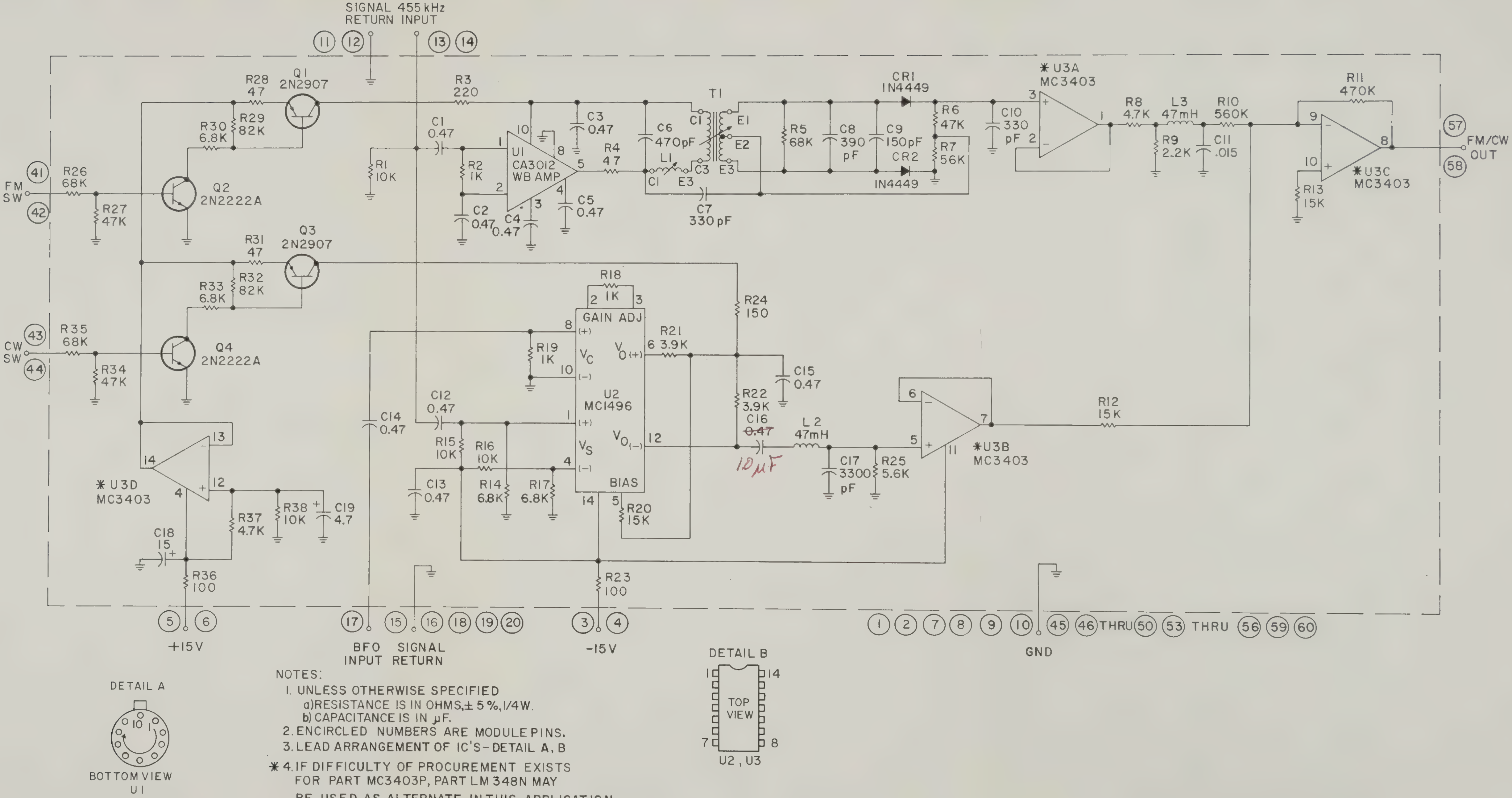


Figure 6-11. Type 791599 FM/CW/SSB Detector (A4A9), Schematic Diagram 43198



NOTES:
1. UNLESS OTHERWISE SPECIFIED
   a) RESISTANCE IS IN OHMS, ± 5%, 1/4W.
   b) CAPACITANCE IS IN μF.
2. ENCIRCLED NUMBERS ARE MODULE PINS.
3. LEAD ARRANGEMENT OF IC'S - DETAIL A, B
✱ 4. IF DIFFICULTY OF PROCUREMENT EXISTS FOR PART MC3403P, PART LM348N MAY BE USED AS ALTERNATE IN THIS APPLICATION.

Figure 6-11. Type 791599 FM/CW/SSB Detector (A4A9), Schematic Diagram 43198

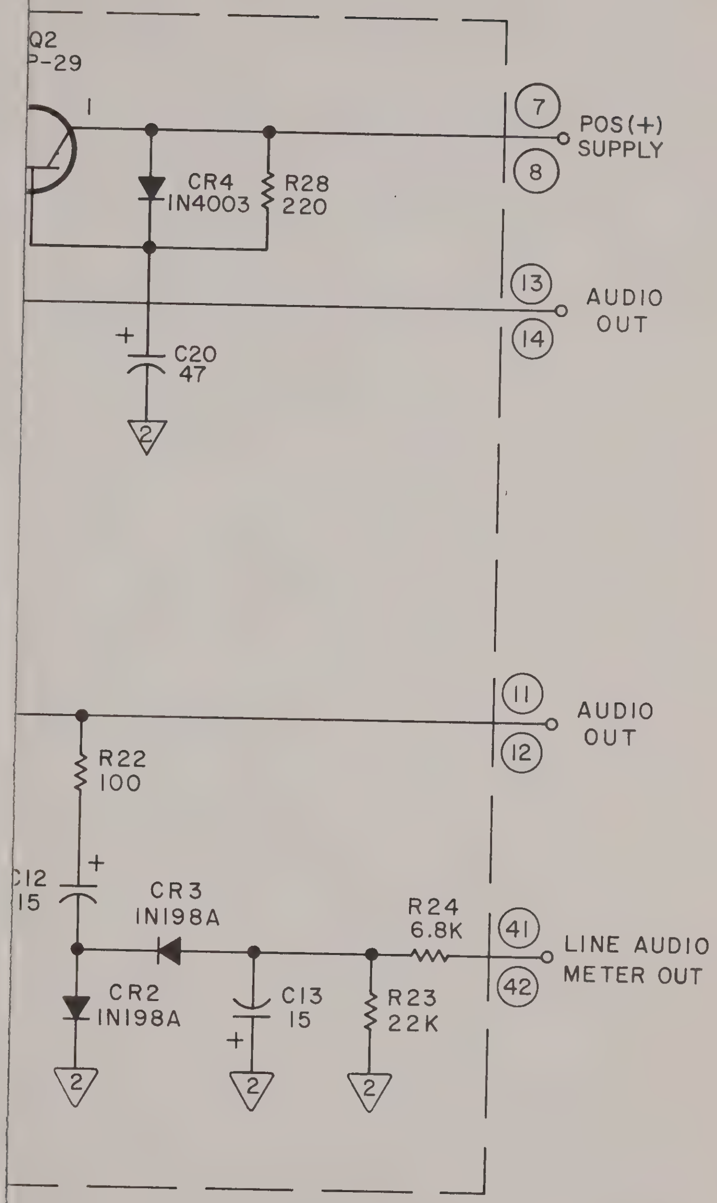
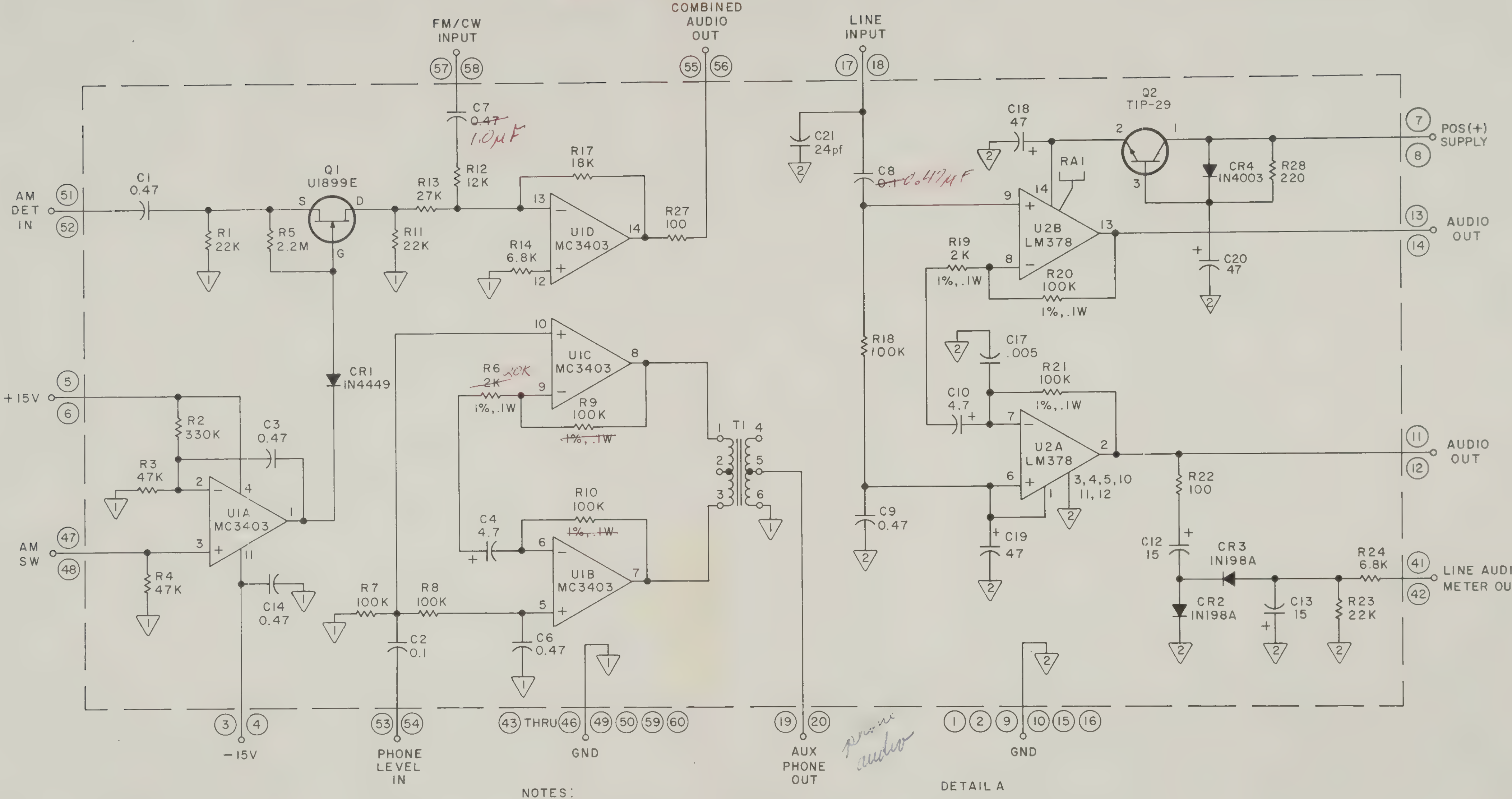


Figure 6-12. Type 7459 Audio Amplifier (A4A10), Schematic Diagram 43230

see addendum
Jan 25 1970



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN μF.
2. ENCIRCLED NUMBERS ARE MODULE PINS.
3. U1, U2 LEAD ARRANGEMENT – DETAIL A.

DETAIL A

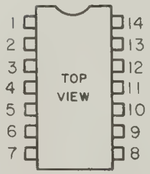


Figure 6-12. Type 7459 Audio Amplifier (A4A10), Schematic Diagram 43230

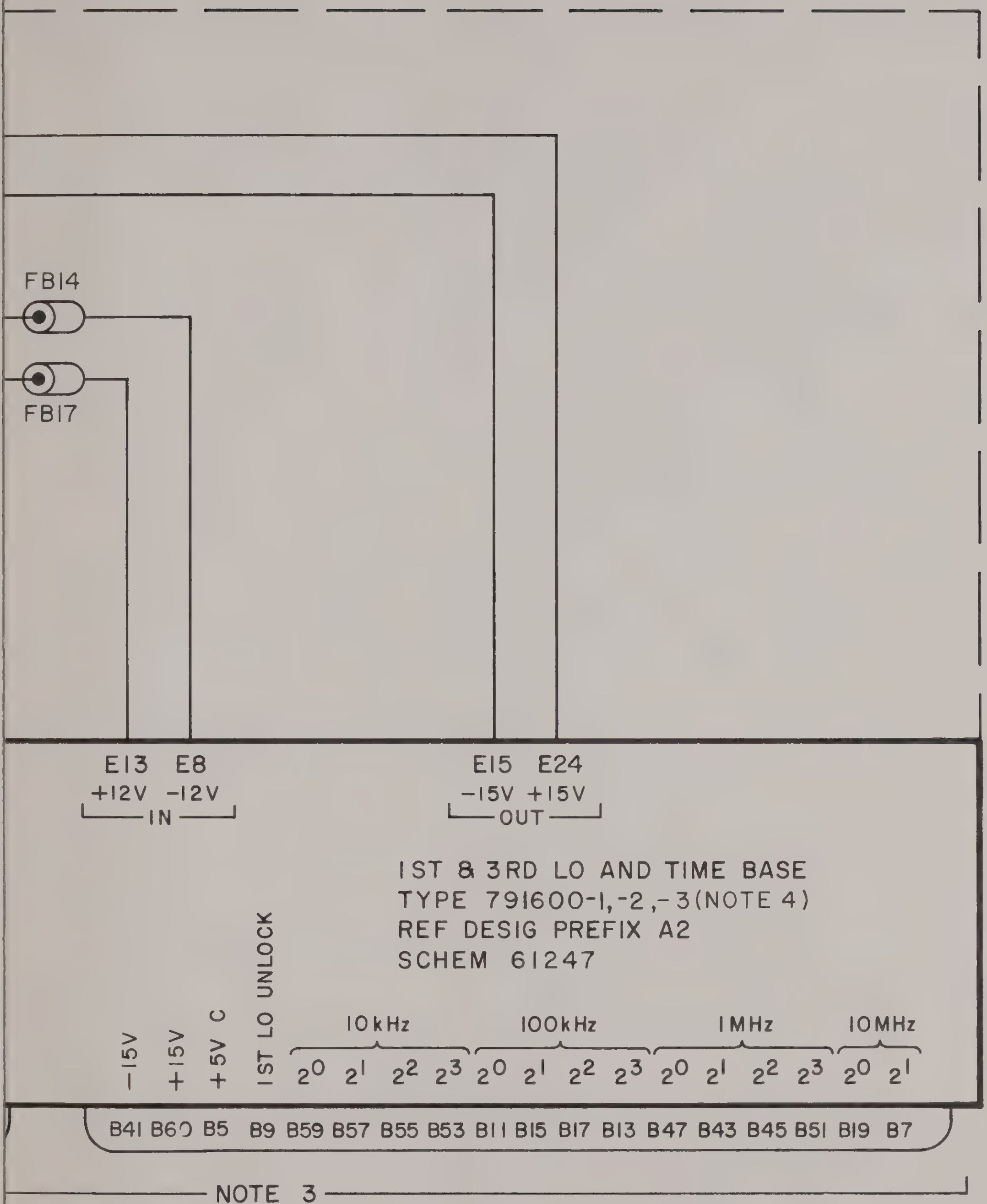
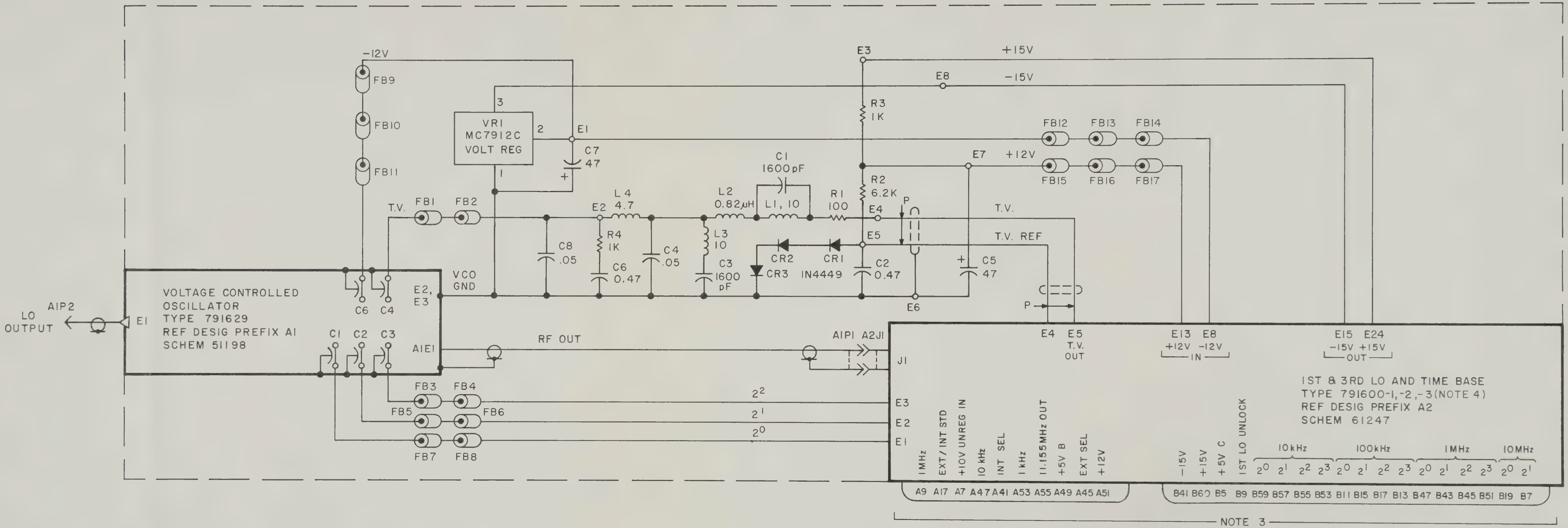


TABLE B

TYPE	A2
791630-1	791600-1
791630-2	791600-2
791630-3	791600-3

6-13. Type 791630 1st and 3rd LO Synthesizer/Time Base Assembly (A5A1), Schematic Diagram 43305



NOTES:

1. UNLESS OTHERWISE SPECIFIED
   - a) RESISTANCE IS IN OHMS, ± 5%, 1/4W
   - b) CAPACITANCE IS IN μF.
   - c) INDUCTANCE IS IN mH.
2. LEAD ARRANGEMENT FOR VR1 IS SHOWN IN DETAIL A.
3. LETTERS (NUMBERS) ARE MODULE (A2) PINS. GND PINS FOR GND_1, GND_2, GND_3, ARE LISTED IN TABLE A.
4. DIFFERENCE BETWEEN TYPES IS SHOWN IN TABLE B.

DETAIL A

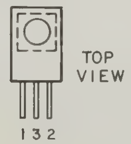


TABLE A

GND	MODULE PIN
GND_1	A48, 50, 52, 54, 56, 58, 60
GND_2	A2, 4, 6, 8, 10, 14, 16, 18, 20, 42, 44, 46
GND_3	B2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 42, 44, 46, 48, 50, 52, 54, 56, 58

TABLE B

TYPE	A2
791630-1	791600-1
791630-2	791600-2
791630-3	791600-3

Figure 6-13. Type 791630 1st and 3rd LO Synthesizer/Time Base Assembly (A5A1), Schematic Diagram 43305

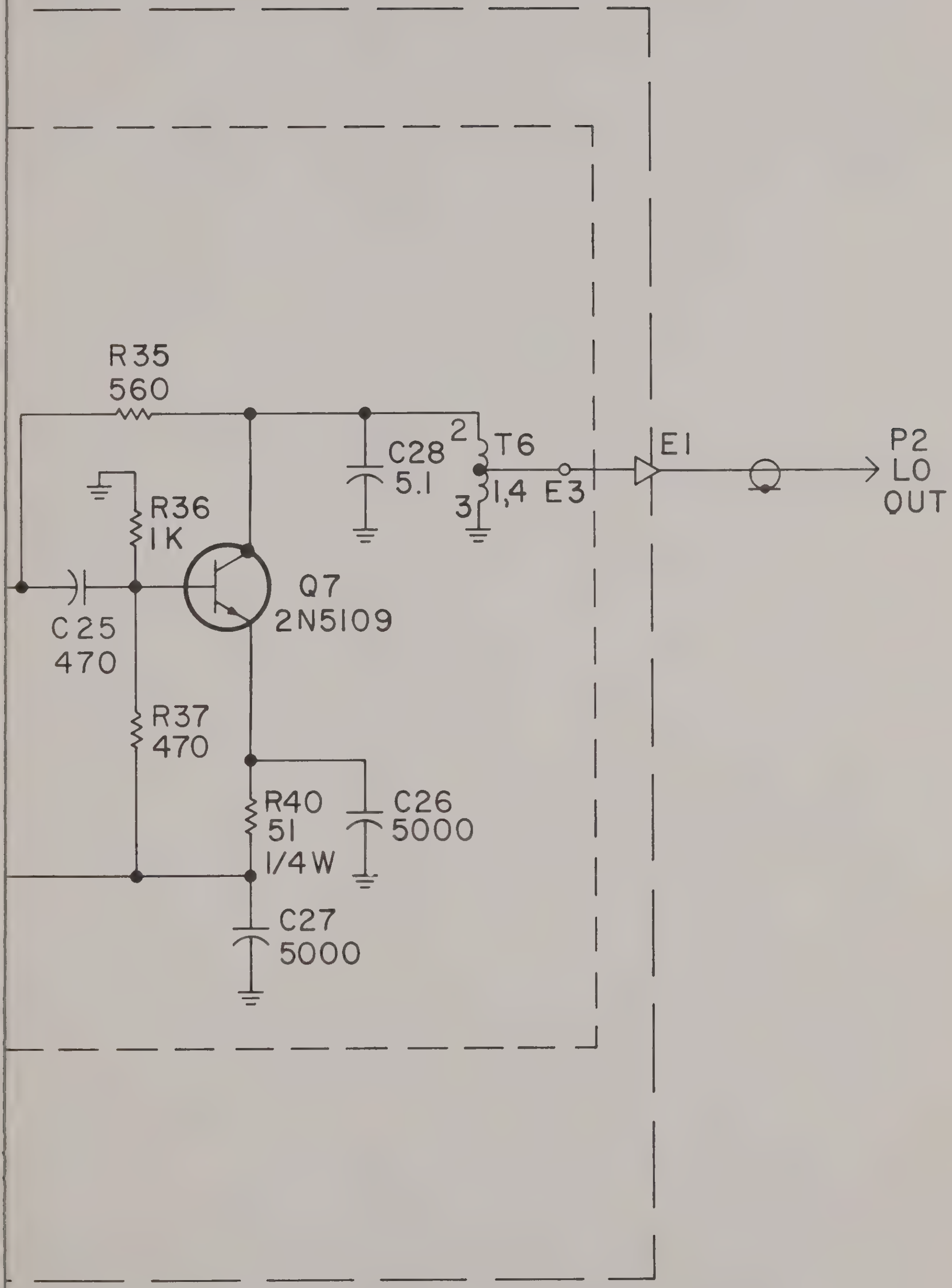
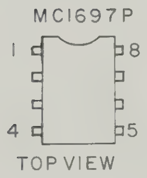


Figure 6-14. Type 791629 Voltage Controlled Oscillator (A5A1A1), Schematic Diagram 51198

NOTES:

1. UNLESS OTHERWISE SPECIFIED
   a) RESISTANCE IS IN OHMS ±5%, 1/8W
   b) CAPACITANCE IS IN pF.
2. NOMINAL VALUE; FINAL VALUE FACTORY SELECTED.



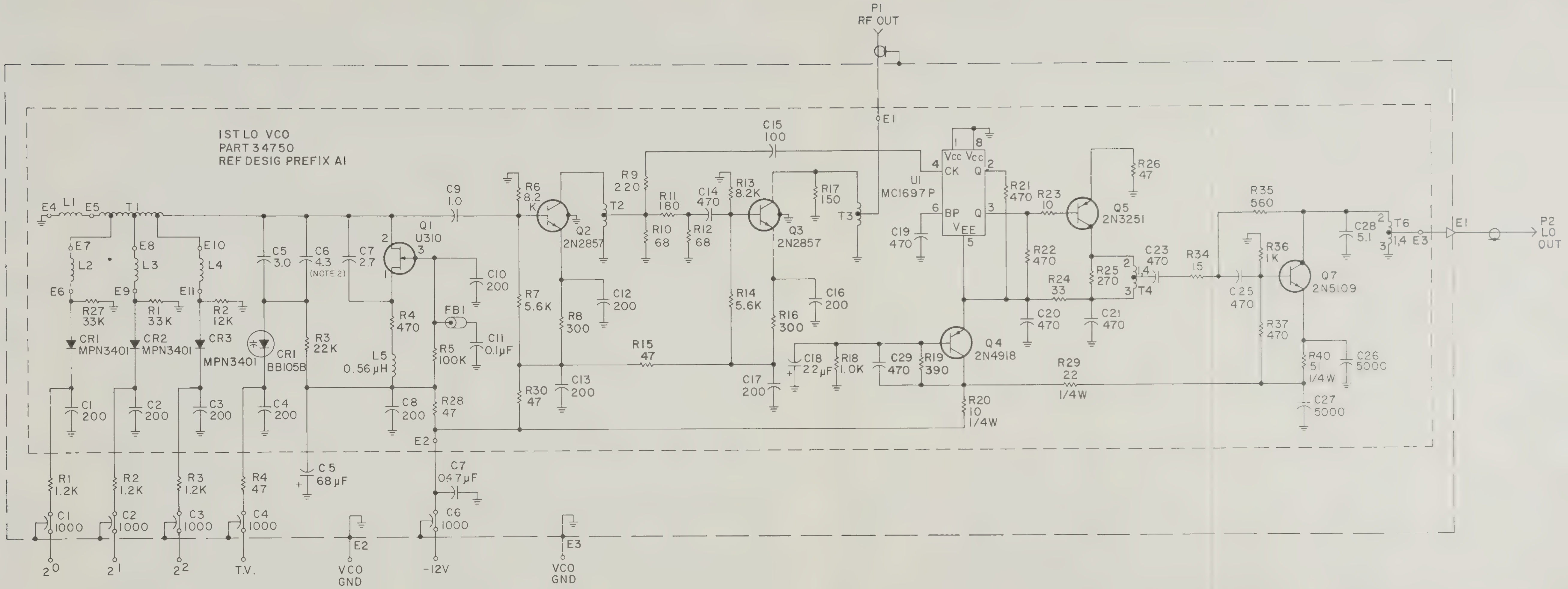


Figure 6-14. Type 791629 Voltage Controlled Oscillator (A5A1A1), Schematic Diagram 51198

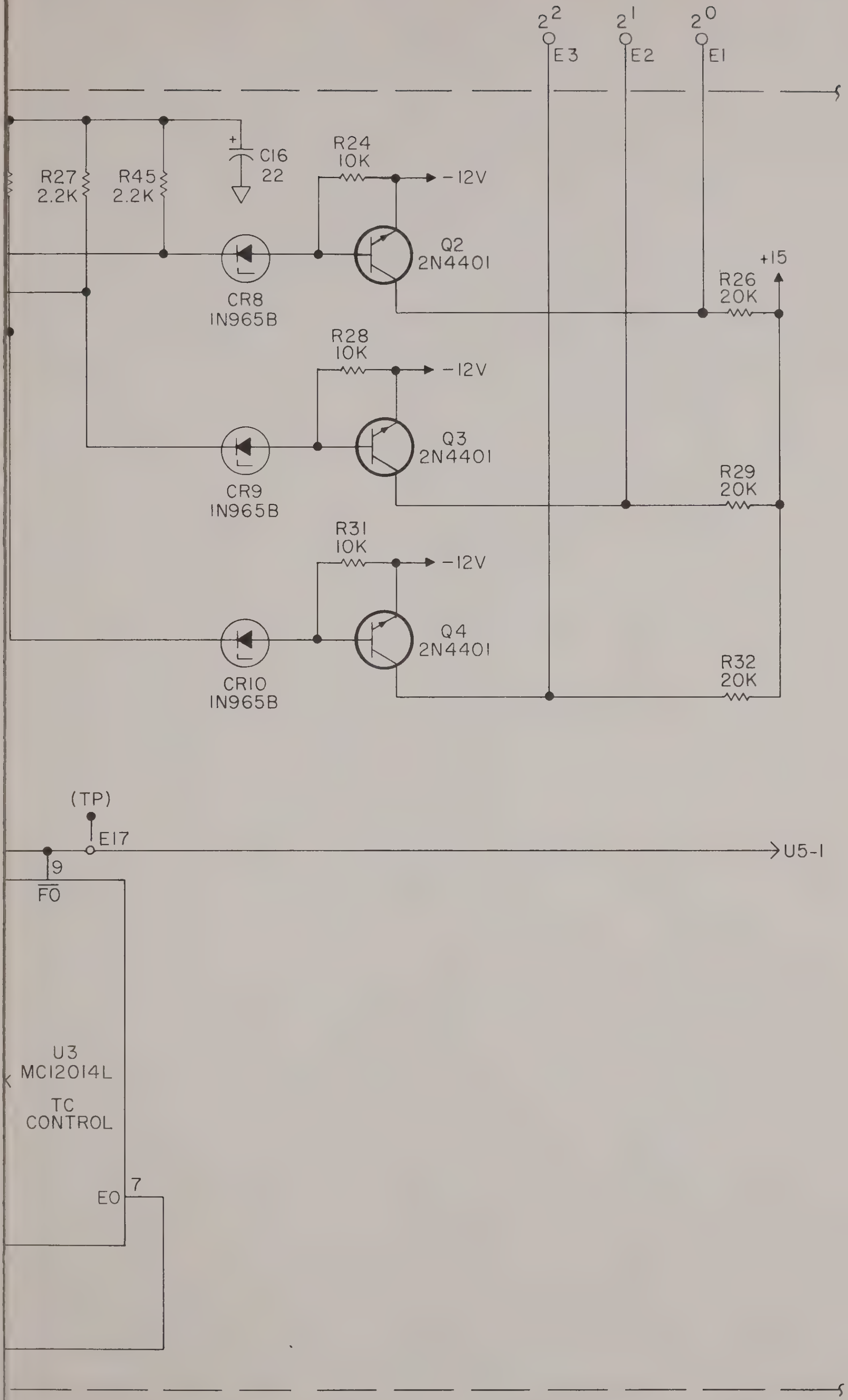


Figure 6-15. Type 791600 1st and 3rd LO Synthesizer/Time Base (A5A1A2), Schematic Diagram 61247 (Sheet 1 of 2)

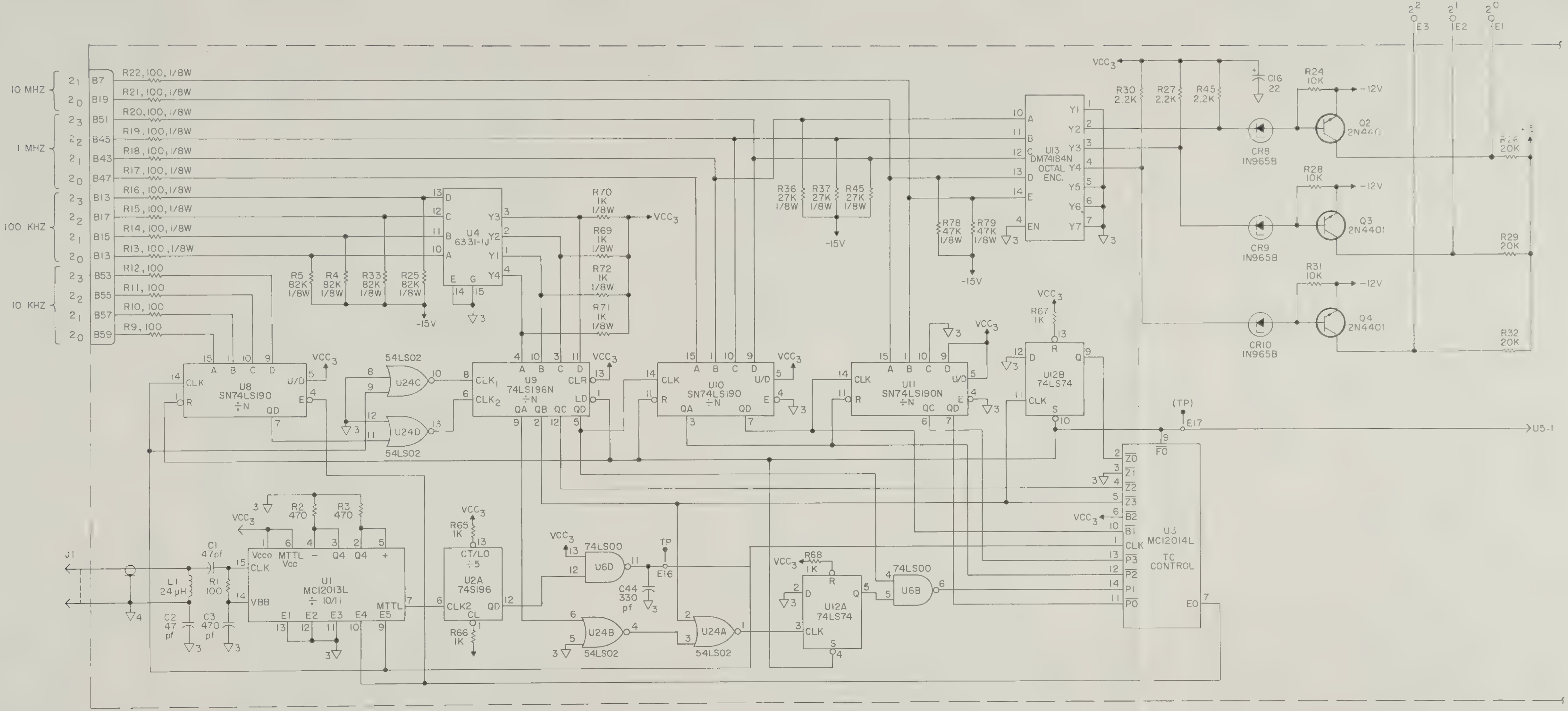


Figure 6-15. Type 791600 1st and 3rd LO Synthesizer/Time Base (A5A1A2), Schematic Diagram 61247 (Sheet 1 of 2)

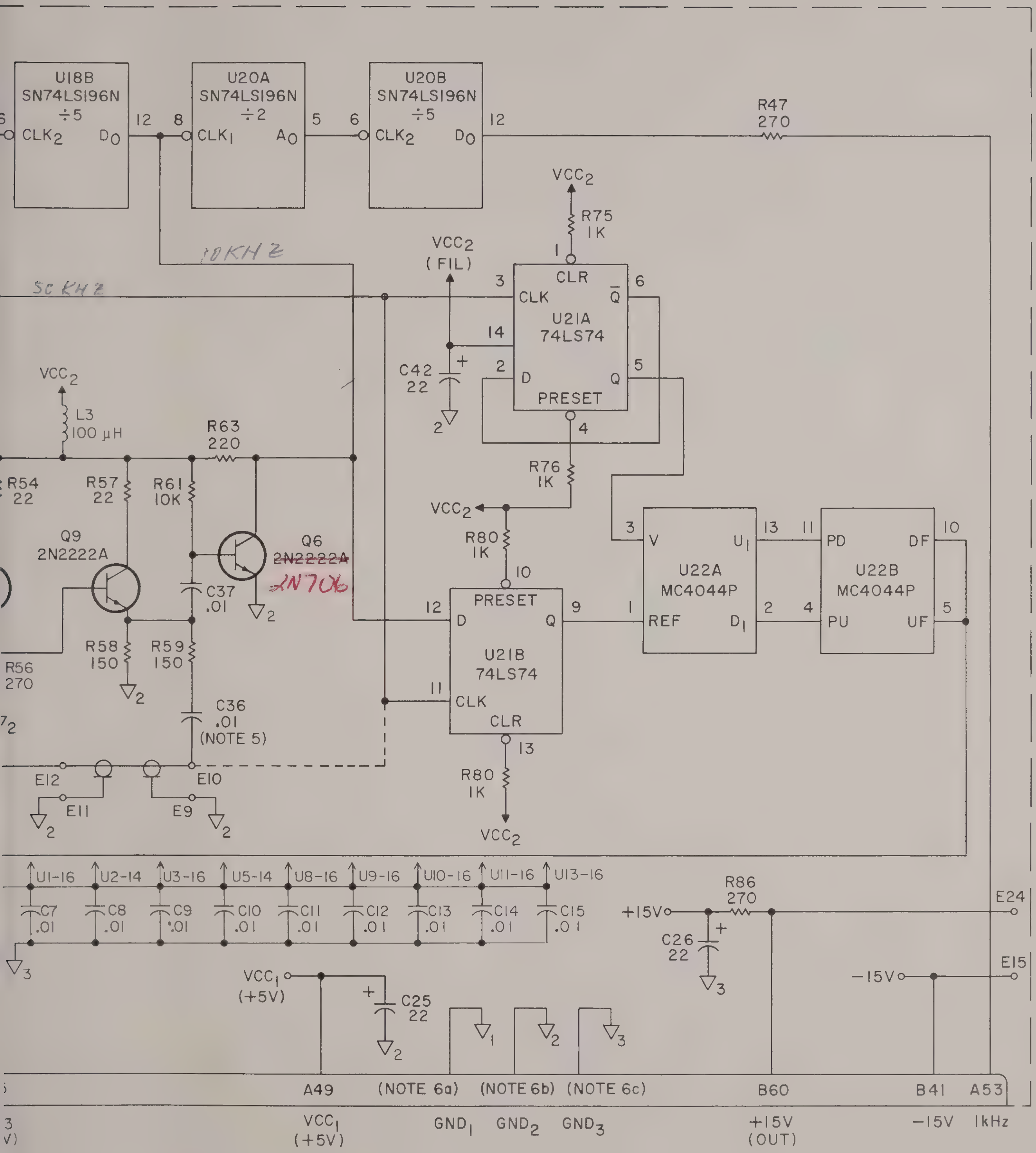


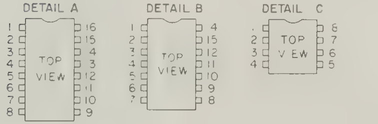
Figure 6-16. Type 791600 1st and 3rd LO Synthesizer/Time Base (A5A1A2), Schematic Diagram 61247 (Sheet 2 of 2)

See addendum Jan 25 '80

NOTES
1. UNLESS OTHERWISE SPECIFIED
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN uF.
2. VCC, GND PINS OF IC,S ARE SHOWN IN TABLE A.
3. LEAD ARRANGEMENT FOR IC,S ARE SHOWN IN TABLE A.
4. NOMINAL VALUE. FINAL VALUE FACTORY SELECTED.
5. DIFFERENCE BETWEEN TYPES IS SHOWN IN TABLE B.
6. GROUND LEVEL PINS ARE LISTED BELOW.
   a) PIN NOS. OF GND LEVEL ONE ARE A48, A50, A52, A54, A5 & A58.
   b) GND LEVEL TWO ARE A2, A4, A6, A8, A10, A12, A 4, A16, A18 A20, A42, A44, A46.
   c) GND LEVEL THREE ARE B2, B4, B6, B8, B10, B12, B14, B16, B18, B20 B42, B44, B46, B48, B50, B52, B54, B56 & B58.

TABLE A

IC	REF DESIG	VCC			GND			DTL	VCC2 (FIL)
		1	2	3	1	2	3		
MC4044P	U5			14			7	B	
MC4044P	U22					7		B	14
MC12013L	U1			16			8	A	
MC12014L	U3			16			8	A	
SN74LS196N	U9			14			7	B	
SN74LS196	U2			14			7	B	
SN74LS00	U6			14			7	B	
82S123	U4			16			8	A	
SN74LS190	U8, U10			16			8	A	
SN74S74	U11			16			8	A	
SN74184	U13			16			8	A	
SN75140	U16	8			4			C	
74LS74	U21					7		B	14
8292	U15, U17	14			7			B	
8292	U18, U20		14			7		B	
741	U7							C	
SN74LS74	U12			14			7	B	
SN74125	U23	14			7			B	
SN74LS02	U24			14			7	B	



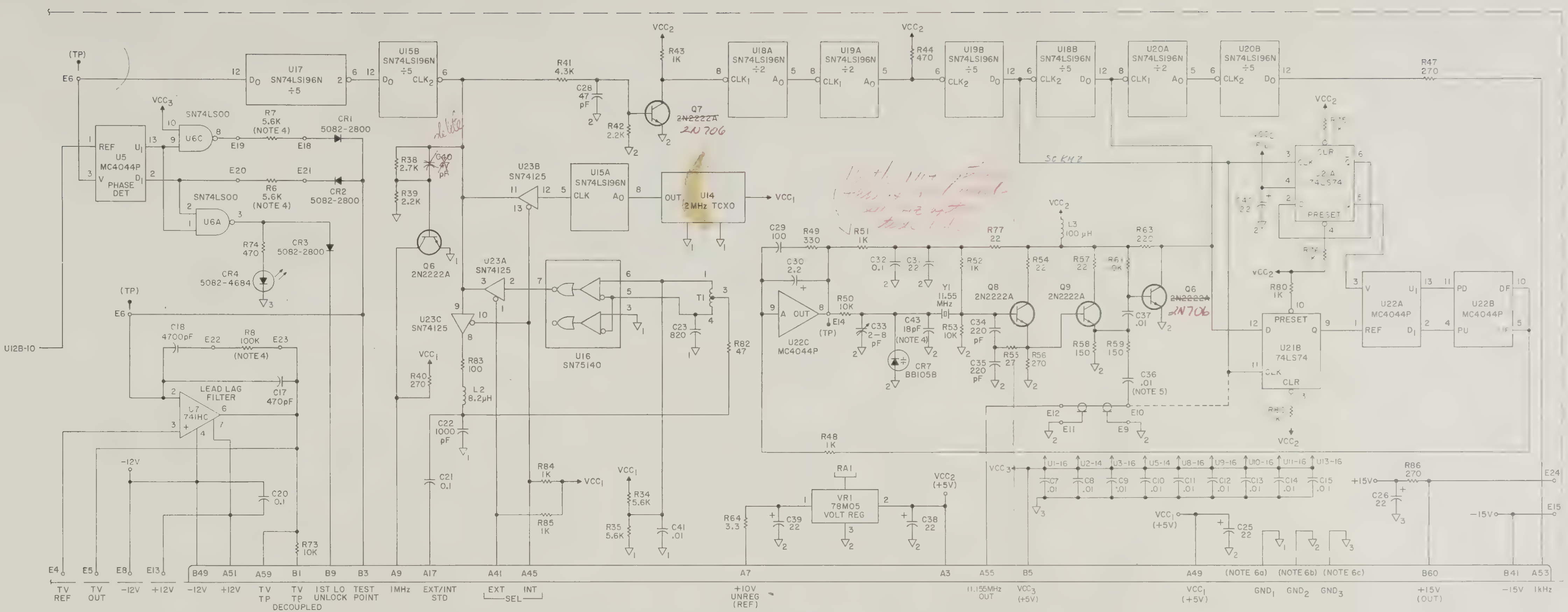


TABLE B

TYPE	C36	L3	W1	U14
791600-1	AS SHOWN	AS SHOWN	NOT USED	92063-1
791600-2	NOT USED	NOT USED	AS SHOWN	92063-1
791600-3	AS SHOWN	AS SHOWN	NOT USED	841038

used with

Figure 6-16. Type 791600 1st and 3rd LO Synthesizer/Time Base (A5A1A2), Schematic Diagram 61247 (Sheet 2 of 2)

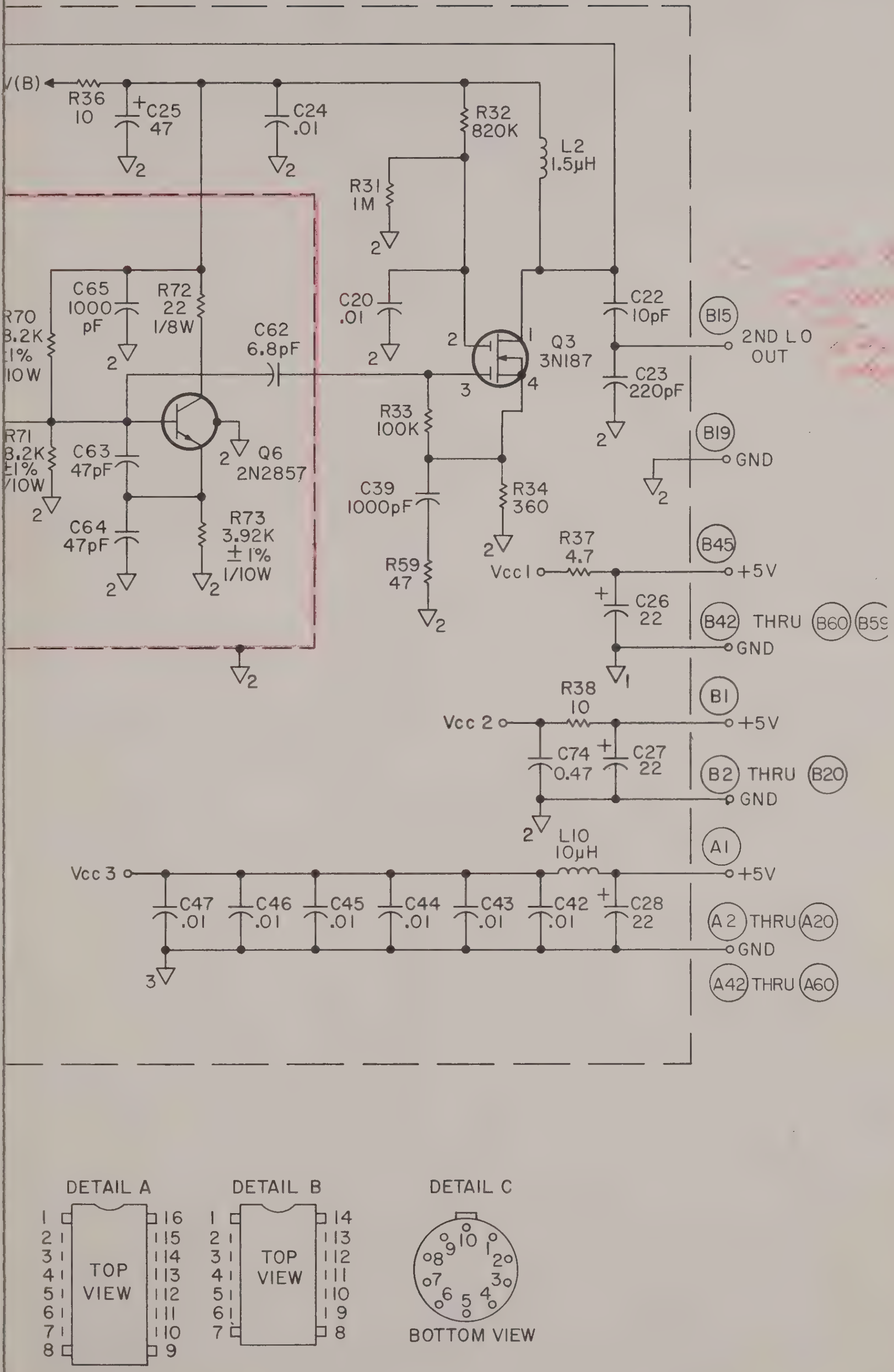
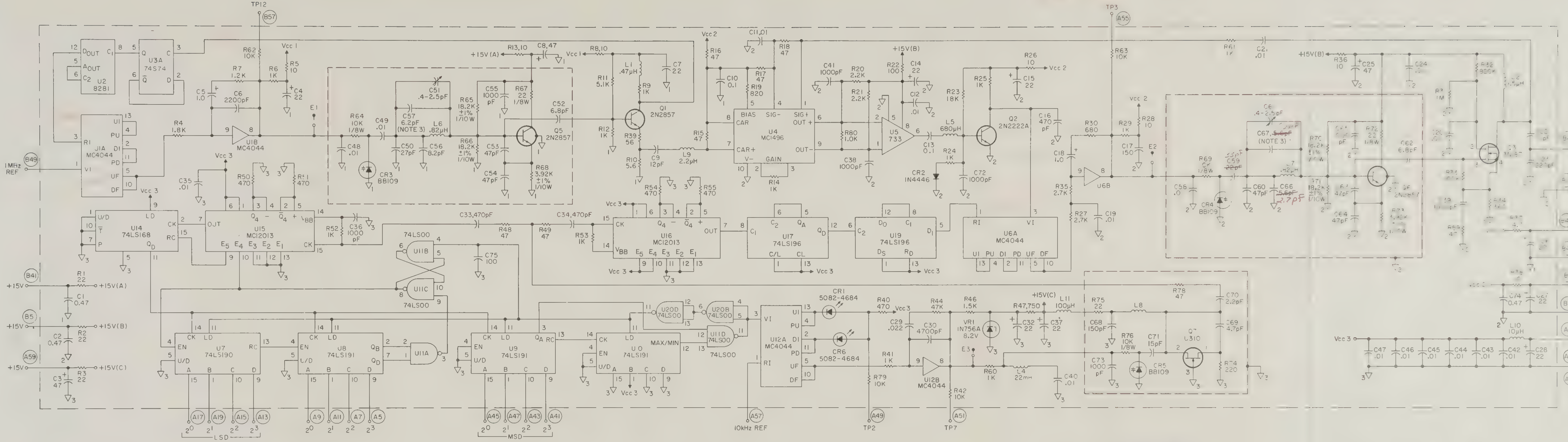


Figure 6-17. Type 791601 2nd LO Synthesizer (A5A2), Schematic Diagram 61256

... Addendum
June 25, 1980

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN μF.
2. PIN ARRANGEMENTS & POWER CONNECTIONS FOR IC'S ARE GIVEN IN TABLE 1.
3. NOMINAL VALUE. FINAL VALUE FACTORY SELECTED.

IC TYPE	REF DESIG	DETAIL	Vcc 1 PIN	Vcc 2 PIN	Vcc 3 PIN	▽1	▽2	▽3
MC4044	U1	B	14			7		
8281	U2	B	14			7		
74S74	U3	B	14			7		
796	U4	C						
733	U5	C						
MC4044	U6	B		14			7	
74LS190	U7,U8	A			6			8
74LS191	U9,U10	A			16			8
74LS00	U11	B			14			7
MC4044	U12	B			14			7
74LS168	U14	A			16			8
MC12013	U15	A			6			8
MC12013	U16	A			6			8
74LS196	U17,U19	B			14			7



REF DESIG	
HIGHEST	NOT USED
C75 CR5 E3 L11 Q7 R80 U19 VR1	C3. R39, R43 R45 U13, U18

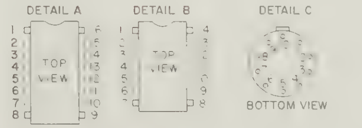


Figure 6-17. Type 791601 2nd LO Synthesizer (A5A2), Schematic Diagram 61256

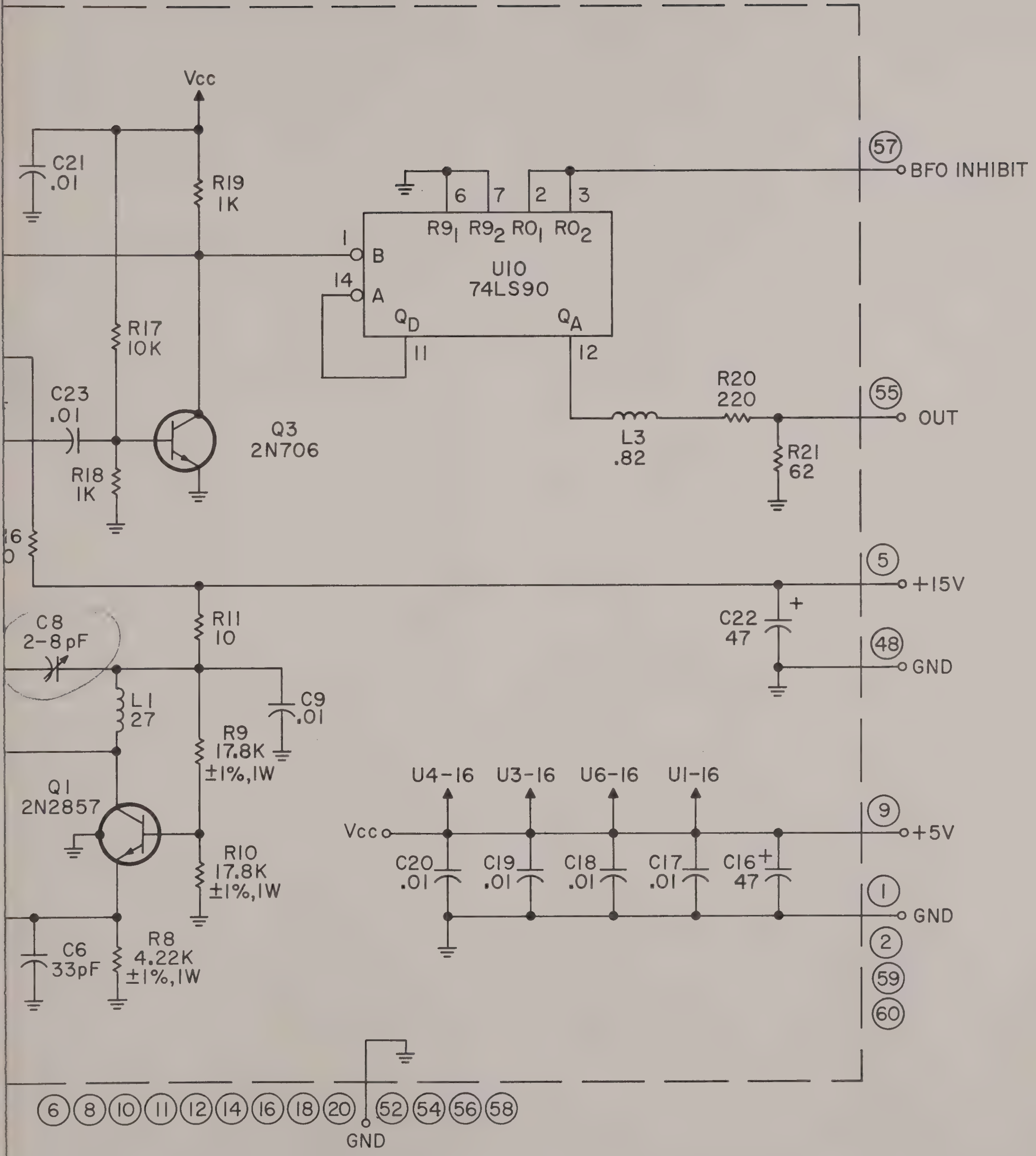


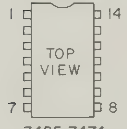
Figure 6-18. Type 791576 BFO Synthesizer (A5A3), Schematic Diagram 51183

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN µF.
   c) INDUCTANCE IS IN µH.
2. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
3. FOR I/C PIN ARRANGEMENTS SEE DETAILS A & B.
4. FOR PIN NOS. OF Vcc & GND SEE TABLE A.

TABLE A

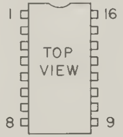
I/C	REF DESIG	Vcc	GND
74LS190	U1,U2,U3,U4	16	8
7425	U5,U7	14	7
74LS11	U6	14	7
7474	U8	14	7
MC4044P	U9	14	7
74LS90	U10	14	7

DETAIL A



7425,7474
MC4044P
74LS90
74LS11

DETAIL B



74LS190

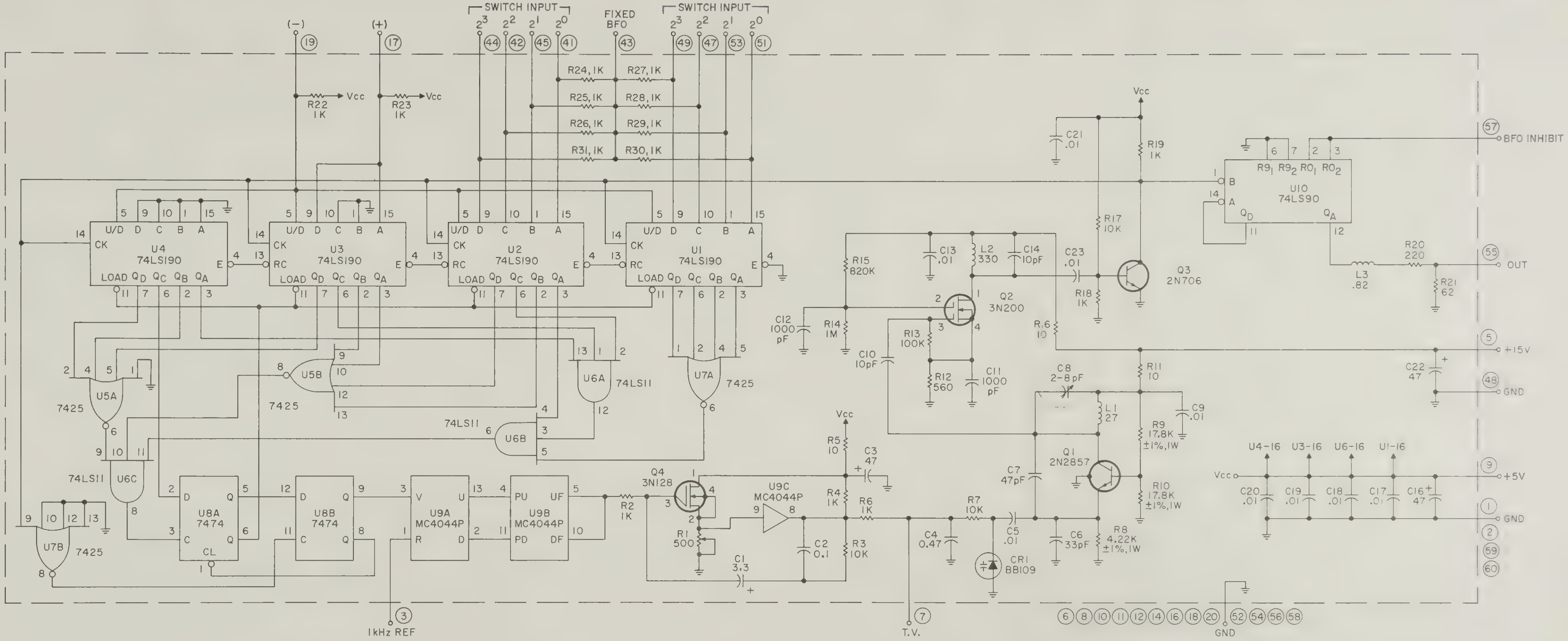


Figure 6-18. Type 791576 BFO Synthesizer (A5A3), Schematic Diagram 51183

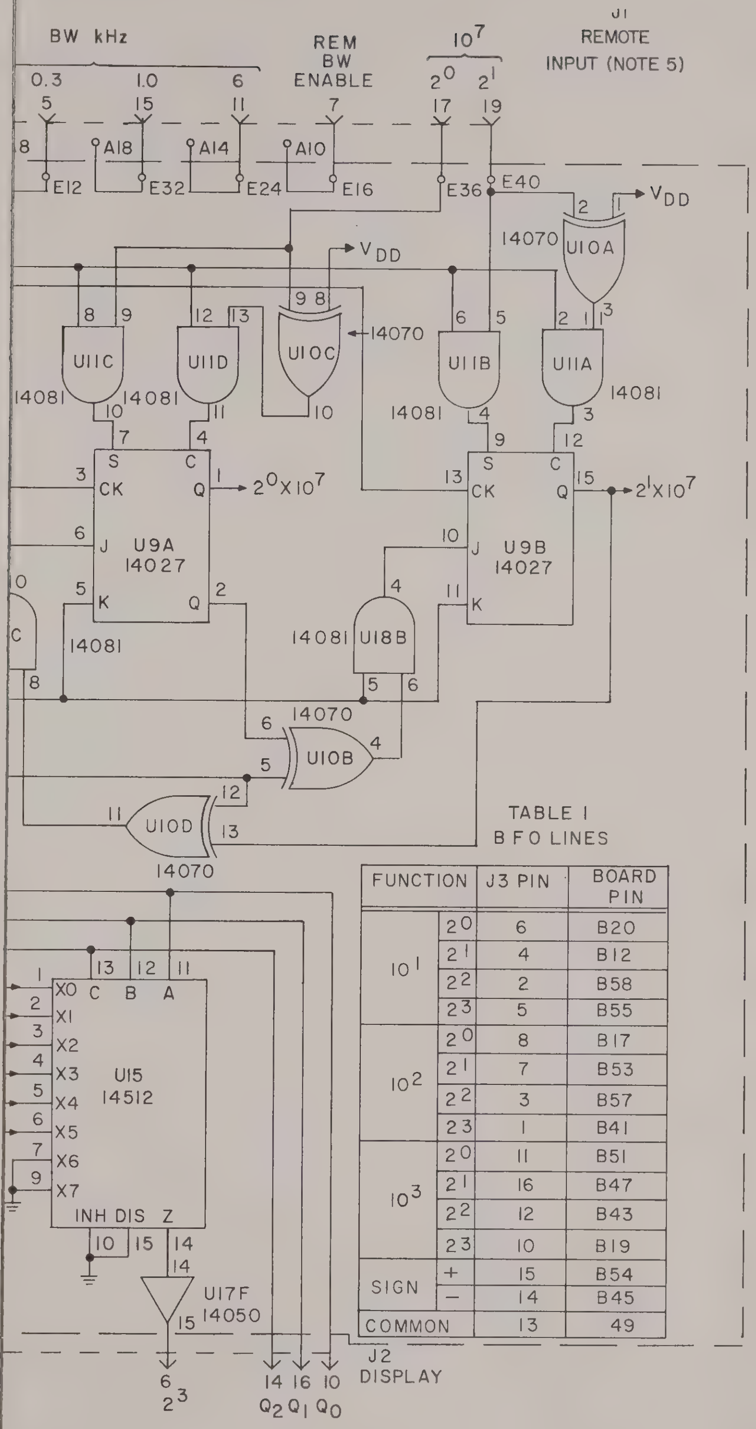


TABLE I
B F O LINES

FUNCTION		J3 PIN	BOARD PIN
10^1	2^0	6	B20
	2^1	4	B12
	2^2	2	B58
	2^3	5	B55
10^2	2^0	8	B17
	2^1	7	B53
	2^2	3	B57
	2^3	1	B41
10^3	2^0	11	B51
	2^1	16	B47
	2^2	12	B43
	2^3	10	B19
SIGN	+	15	B54
	–	14	B45
COMMON		13	49

pe 791575-2 Manual Tuning Up/Down Counter (A6A1),
ematic Diagram 51180

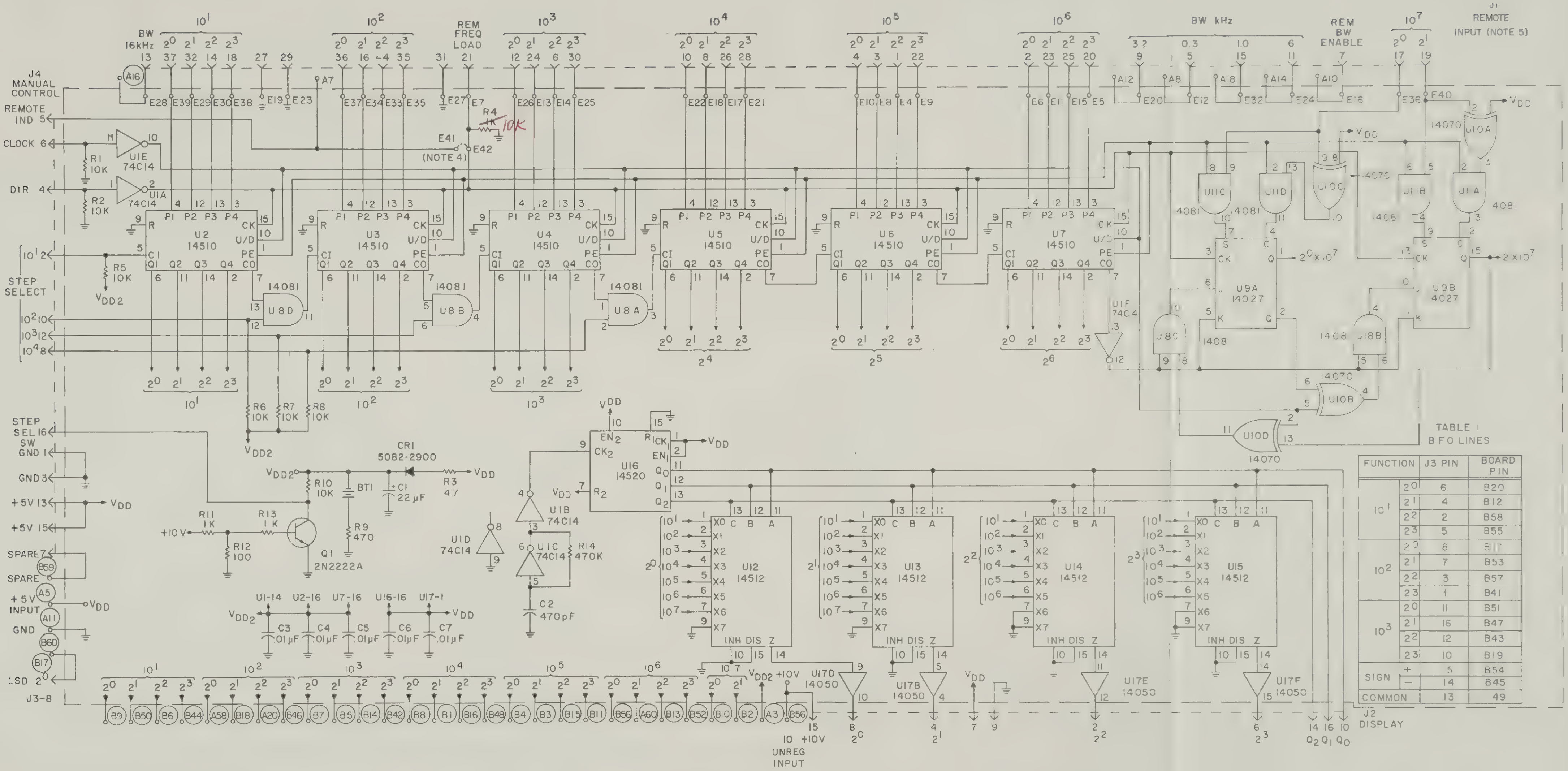


TABLE 1
B F O LINES

FUNCTION		J3 PIN	BOARD PIN
10^1	2^0	6	B20
	2^1	4	B12
	2^2	2	B58
	2^3	5	B55
10^2	2^0	8	B17
	2^1	7	B53
	2^2	3	B57
	2^3	1	B41
10^3	2^0	11	B51
	2^1	16	B47
	2^2	12	B43
	2^3	10	B19
SIGN	+	5	B54
	–	14	B45
COMMON		13	49

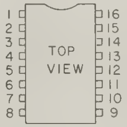
NOTES·

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE IS IN OHMS ± 5%, 1/4 W
2. POWER CONNECTIONS AND PIN ARRANGEMENTS FOR ICs ARE GIVEN IN TABLE 2
3. ENCIRCLED NUMBERS ARE MODULE PIN NUMBERS.
4. REMOVE JUMPER BETWEEN E42 AND E41 FOR EXTERNALLY ACTIVATED REMOTE CONTROL. THE PRESENSE OF THE JUMPER PROVIDES FRONT-PANEL ACTIVATED REMOTE CONTROL.
5. DIFFERENCE BETWEEN TYPES IS J1 REMOTE INPUT CABLE IS NOT USED ON DASH-1 VERSION

TABLE 2

IC	V_{DD} PIN	V_{DD2} PIN	GND PIN	DETAIL
U1, U8, U18		14	7	B
U2-U7, U9, U12-U15		16	8	A
U10, U11	14		7	B
U16	16		8	A
U17	1		8	A

DETAIL-A



DETAIL-B

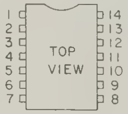


Figure 6-19. Type 791575-2 Manual Tuning Up/Down Counter (A6A1), Schematic Diagram 51180

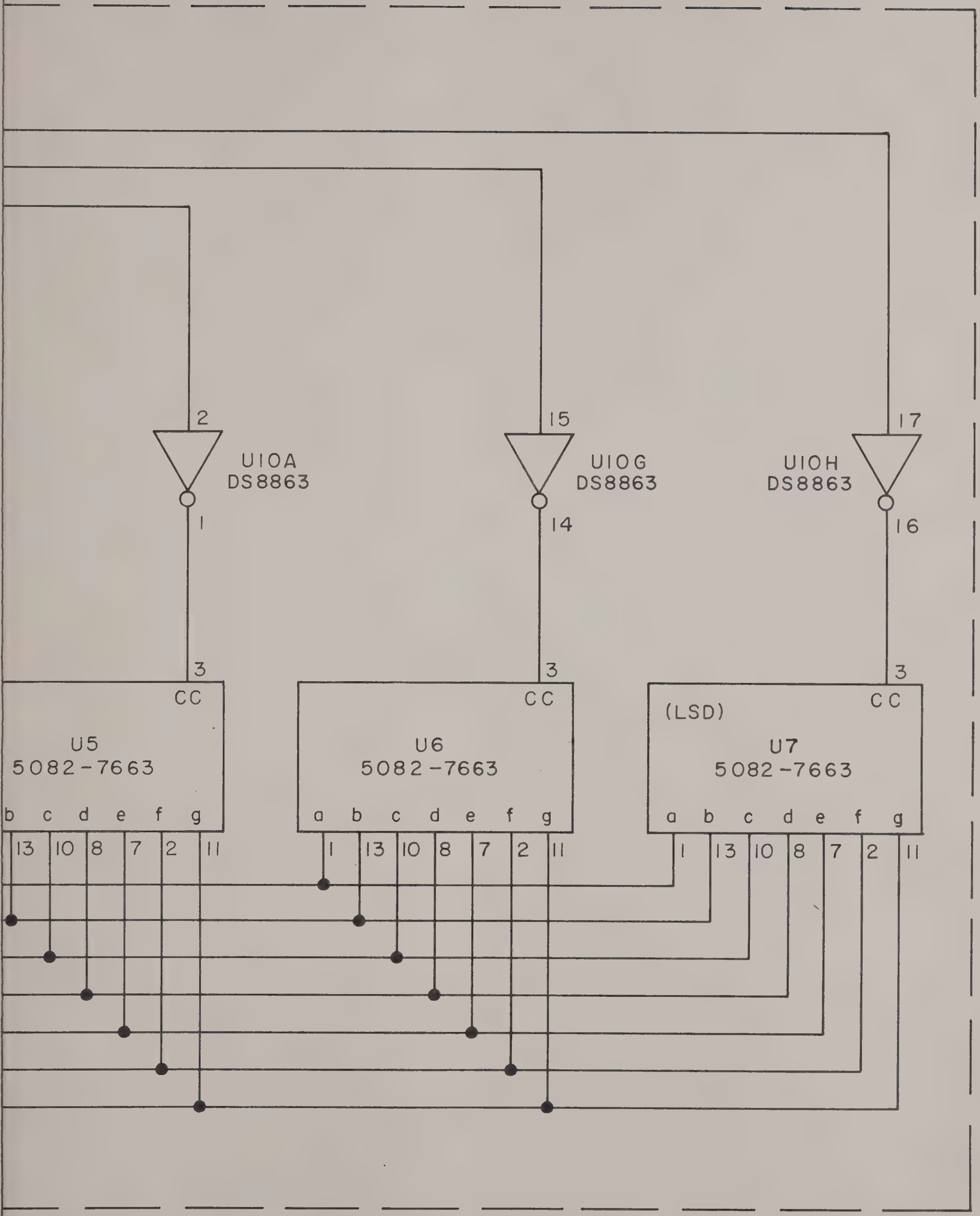
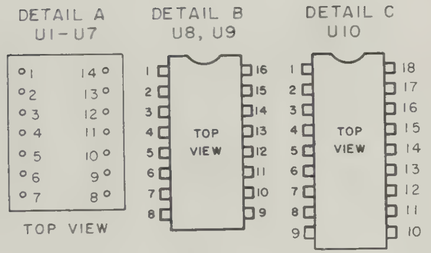


Figure 6-20. Type 791578 Frequency Display (A8), Schematic Diagram 43242

NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTANCE IS IN OHMS, ±5%, 1/4W.
2. U10 PIN 18 IS +5V; U10 PIN 9 IS GND.
3. PIN ARRANGEMENT FOR ICs IS SHOWN IN DETAILS A–C.



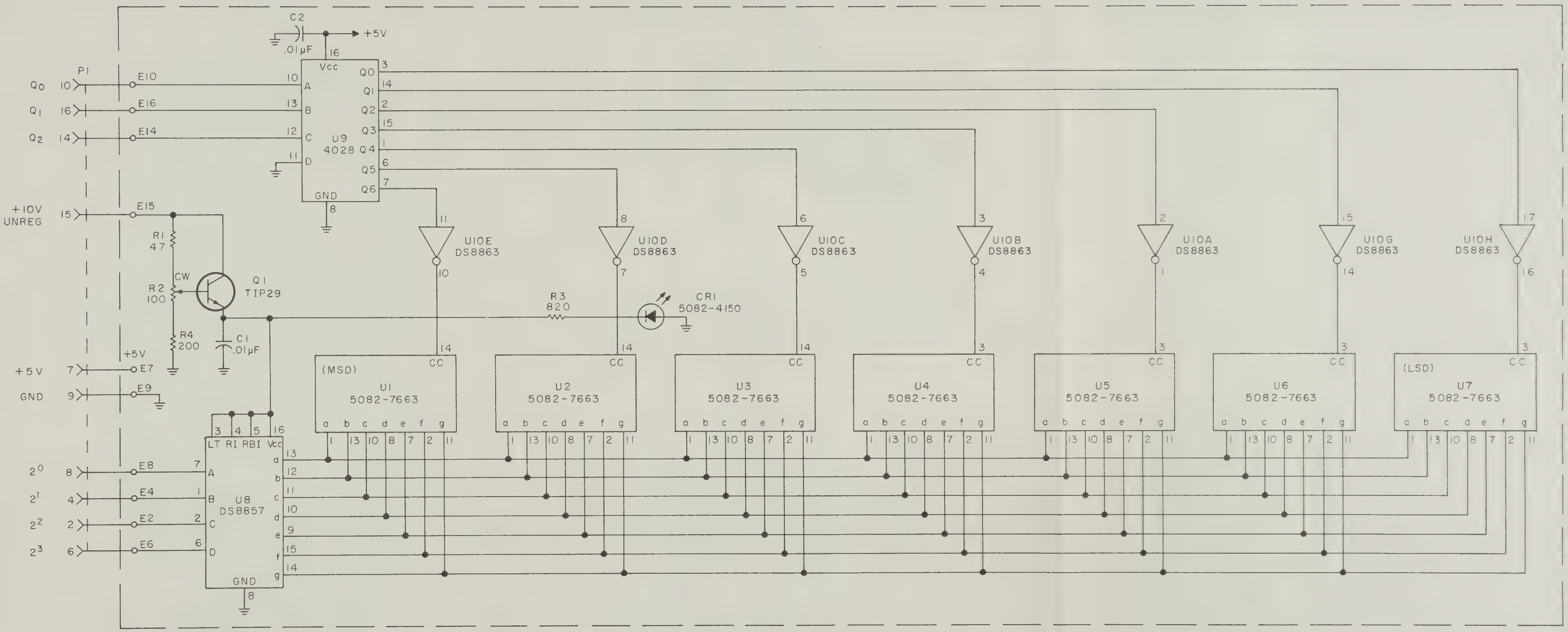
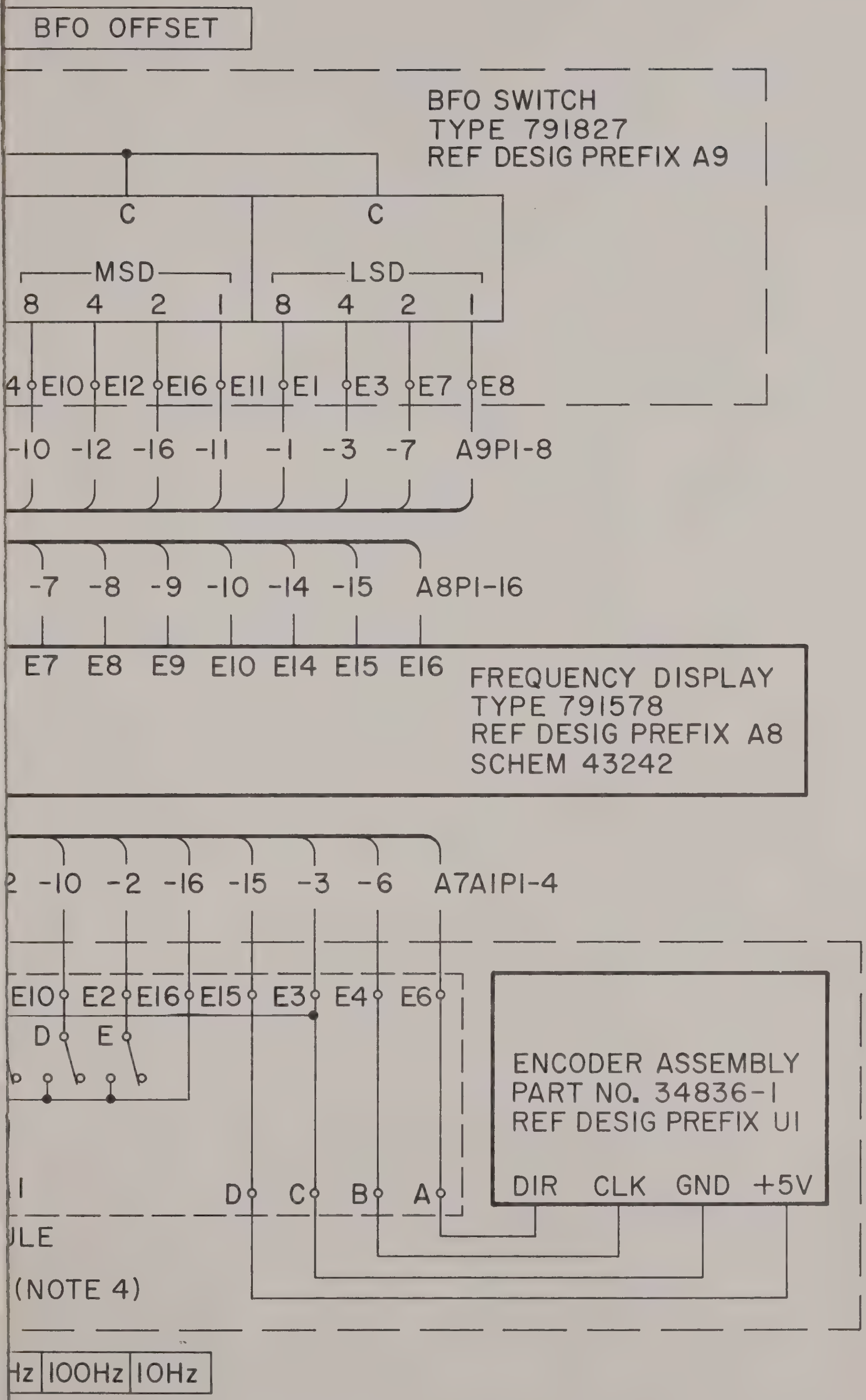


Figure 6-20. Type 791578 Frequency Display (A8), Schematic Diagram 43242



gure 6-21. Type WJ-8718 HF Receiver Main Chassis, Schematic Diagram 580032 (Sheet 1 of 6 and Sheet 5 of 6)

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
   a) RESISTANCE IS IN OHMS, ±5%, 1/4W.
   b) CAPACITANCE IS IN μF.
2. ▭ DENOTES FRONT PANEL CONTROL.
3. SPARE "E" NOS. AND CAPACITORS ARE NOT SHOWN. EACH CAPACITOR REFERENCE NUMBER IS IDENTICAL TO EACH "E" NO.
4. a) SCHEMATIC SHOWN WITH A MANUAL CONTROL MODULE (MCM-2) REMOTE INPUT. REMOTE INPUT CONNECTOR A6A1J1 IS APPLICABLE TO MANUAL CONTROL MODULE (MCM-2) AND REMOTE CONTROL MODULE (RCM) ONLY.
   b) FOR MANUAL CONTROL OPERATION WITHOUT REMOTE INPUT (MCM-1) REPLACE A6A1 ONLY.
   c) FOR REMOTE CONTROL OPERATION, REPLACE A6A1 AND A7 WITH REMOTE CONTROL MODULE (RCM).
5. A10A1, AND A10A2 ARE PART OF:

   FRONT PANEL CONTROL
   TYPE 791684
   REF DESIG PREFIX A10
6. MOST MODULE PINS ARE NOT SHOWN DUE TO UNNECESSARY LINE DUPLICATIONS. GROUND PINS ON SOME MODULES ARE NOT SHOWN BECAUSE OF COMPLEXITY (SEE EACH MODULE'S DWG FOR CLARITY).
7. TEST POINT/PINS NOT SHOWN ARE: A5A1, MODULE PINS B3 (TP1), A13 (TP2) TIED TO A17, A60 (TP3) TIED TO A55 B9 (TP5), B1 (TP6); A5A2, MODULE PINS A51 (TP7), A55 (TP8), A49 (TP10), B57, (TP12).

8. TEST POINT DESCRIPTIONS:

A5 — TP1 N/U
TP2 1MHz REF
TP3 3RD LO
TP4 N/U
TP5 1ST LO UNLOCK
TP6 1ST LO TUNING VOLTS
TP7 2ND LO MAIN LOOP TUNING VOLTS
TP8 2ND LO 32.2 MHz TUNING VOLTS
TP9 10 kHz
TP10 2ND LO UNLOCK
TP11 1MHz REF
TP12 2ND LO 32MHz TUNING VOLTS
TP13 2ND LO OUT
TP14 1kHz REF
TP15 BFO TUNING VOLTS
TP16 BFO OUT
TP17 FIXED BFO
TP18 BFO INHIBIT

A4 — TP1 10.7 MHz INHIBIT
TP2 10.7 MHz FILTER SW OUTPUT
TP3 455 kHz FILTER SW IF OUTPUT
TP4 455 kHz AMPLIFIER OUTPUT
TP5 DETECTED AM
TP6 IF INPUT TO FM/CW/SSB DETECTOR
TP7 FM/CW AUDIO
TP8, TP9 LINE AUDIO
TP10 PHONE AUDIO
TP11 LINE AUDIO LEVEL
TP12 3RD LO INPUT TO 10.7MHz/455kHz CONVERTER
TP13 10.7 MHz/455kHz CONVERTER IF OUTPUT
TP14 ISB IF INPUT
TP15 BFO INPUT
TP16, TP17, TP18 ISB AUDIO
TP19 IF AGC
TP20 N/U
TP21 ISB AGC
TP22 RF AGC

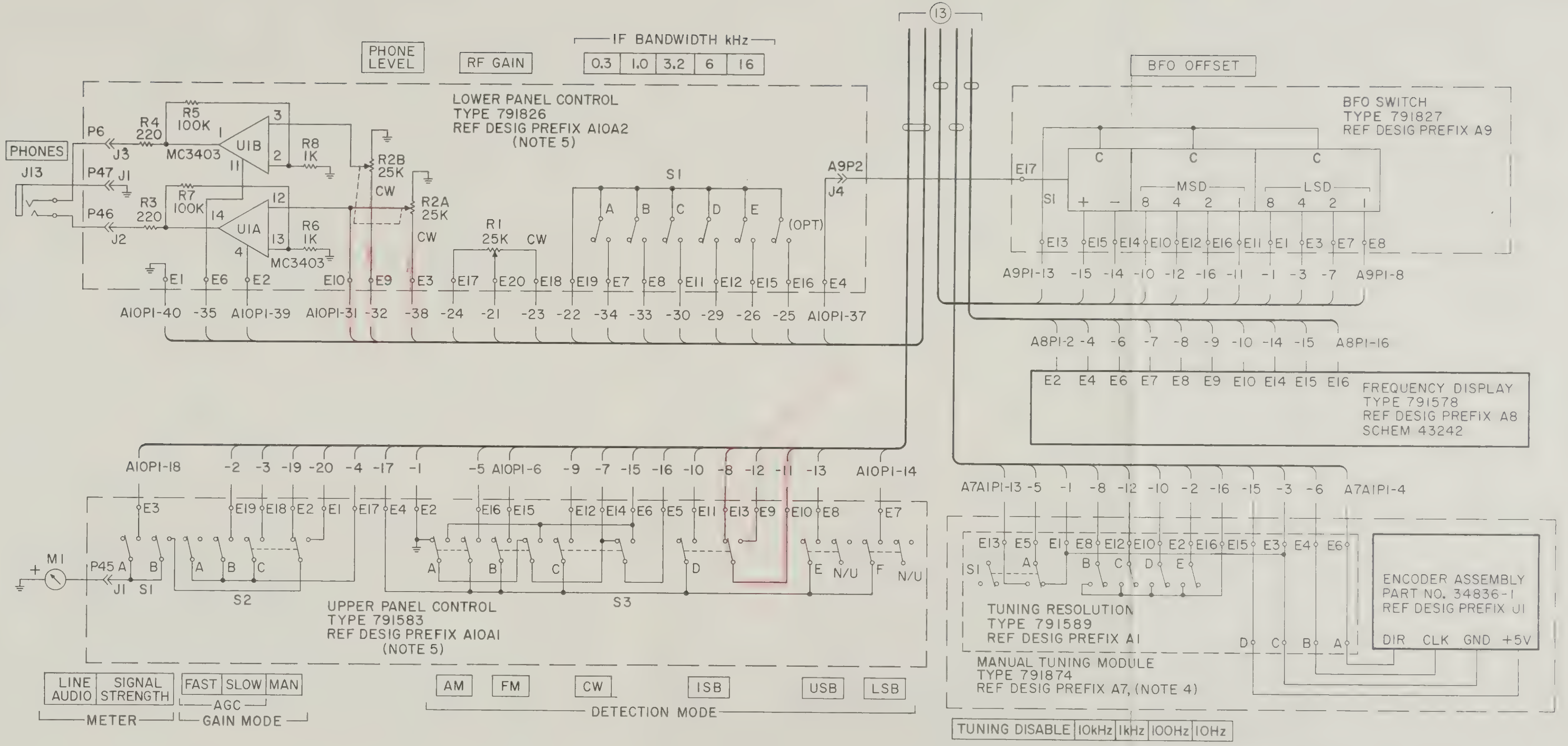


Figure 6-21. Type WJ-8718 HF Receiver Main Chassis, Schematic Diagram 580032 (Sheet 1 of 6 and Sheet 5 of 6)

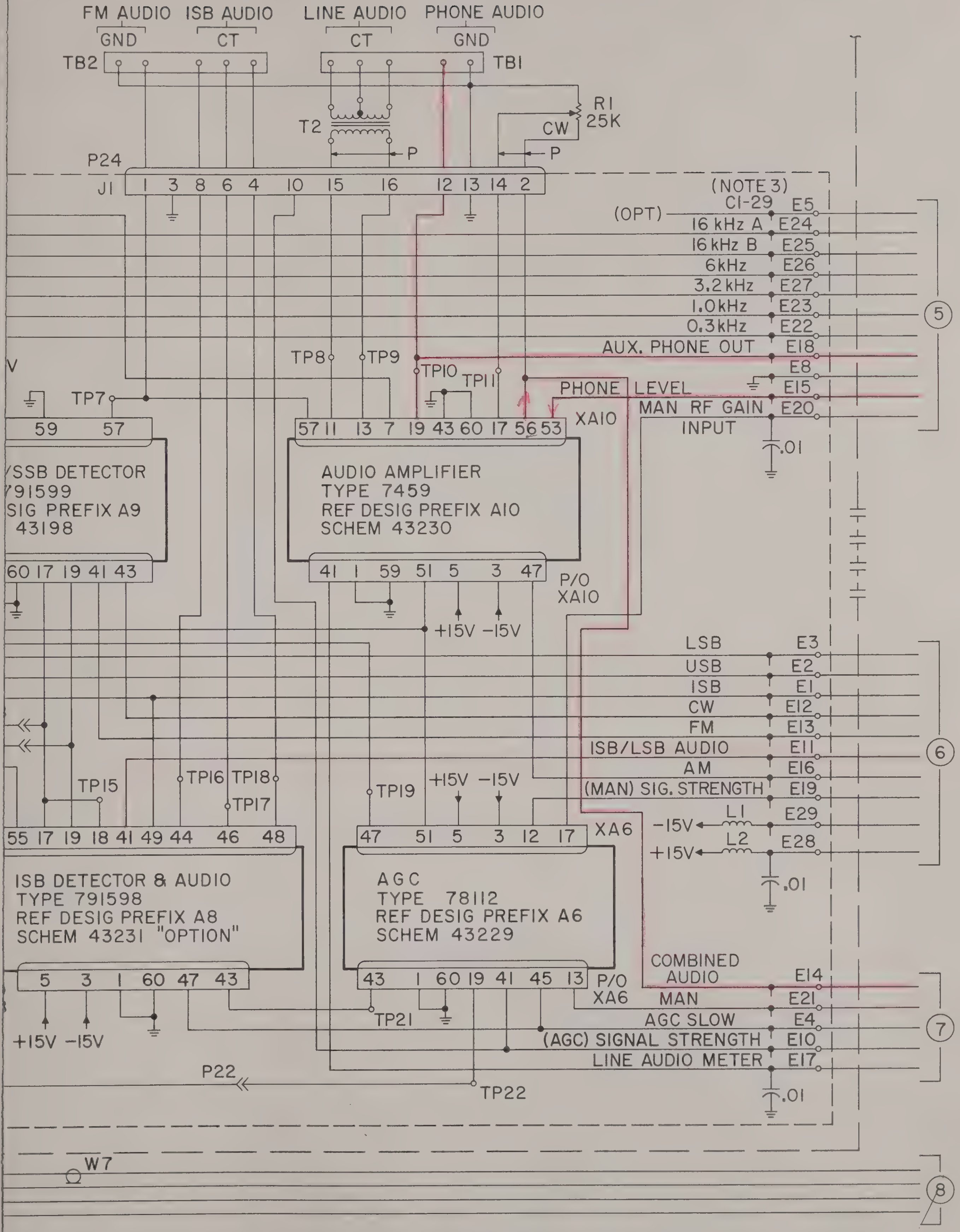


Figure 6-22. Type WJ-8718 HF Receiver Main Chassis, Schematic Diagram 580032 (Sheet 2 of 6 and Sheet 3 of 6)

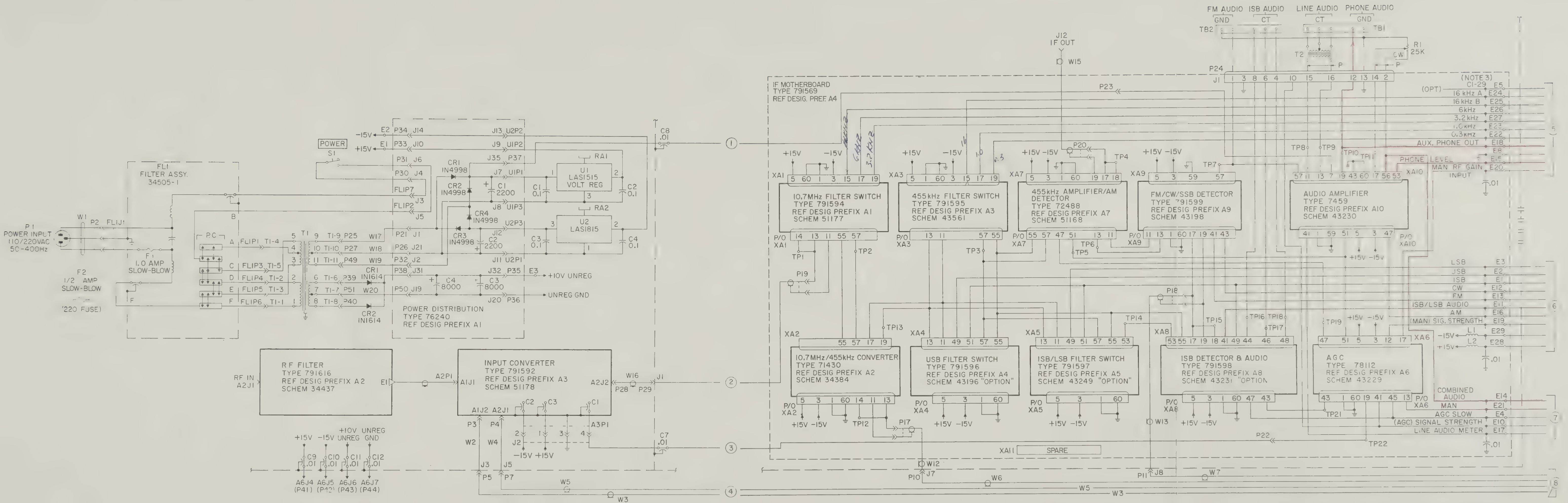


Figure 6-22. Type WJ-8718 HF Receiver Main Chassis, Schematic Diagram 580032 (Sheet 2 of 6 and Sheet 3 of 6)

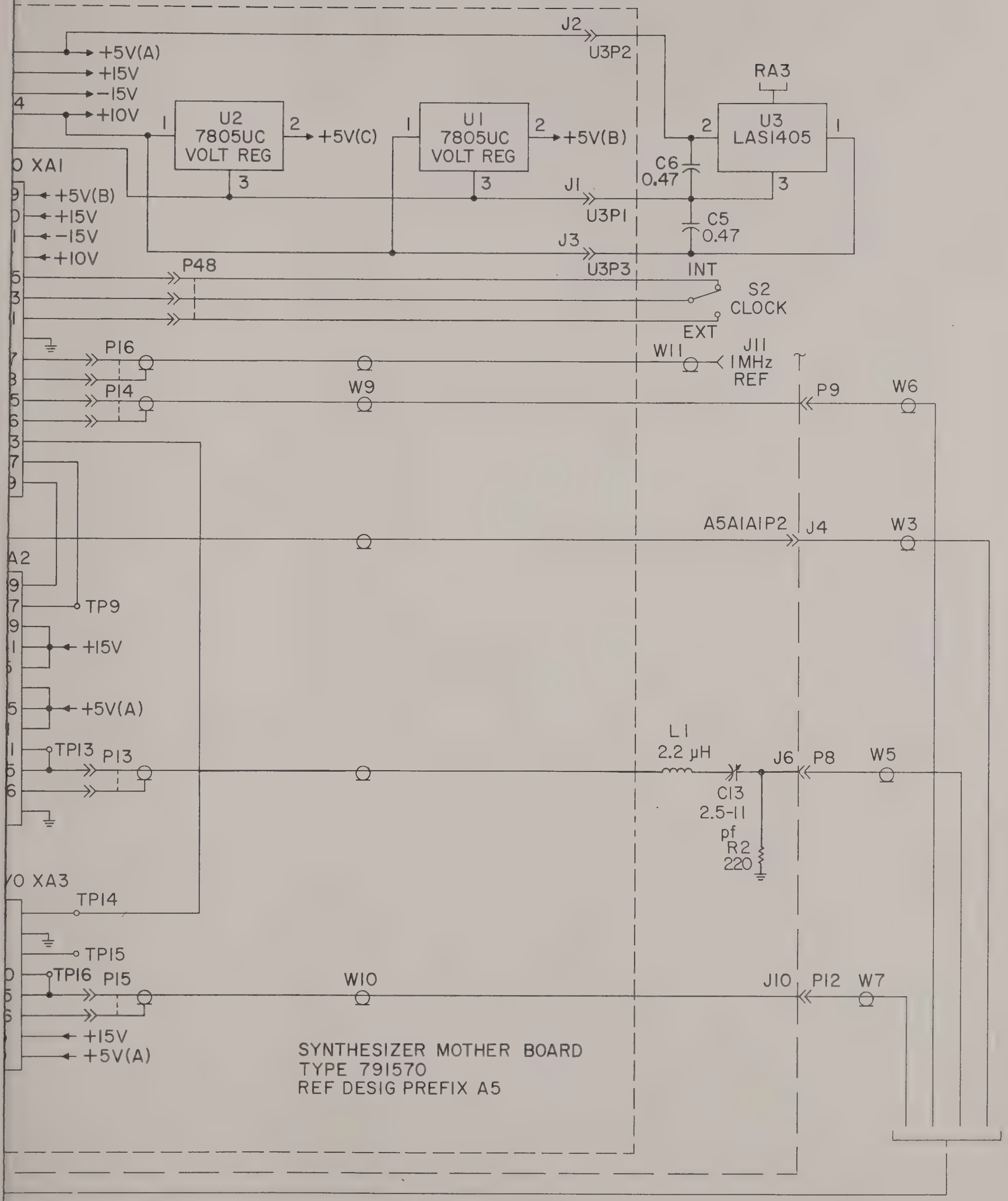


Figure 6-23. Type WJ-8718 HF Receiver Main Chassis, Schematic Diagram 580032 (Sheet 4 of 6 and Sheet 6 of 6),

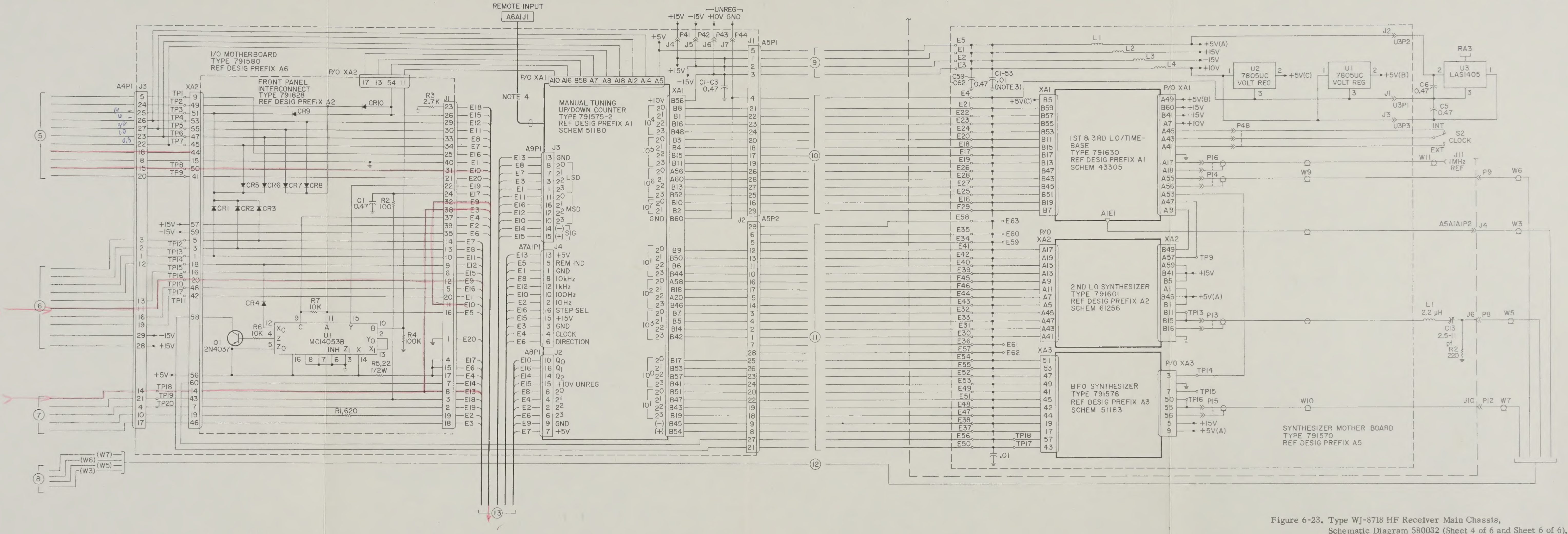


Figure 6-23. Type WJ-8718 HF Receiver Main Chassis, Schematic Diagram 580032 (Sheet 4 of 6 and Sheet 6 of 6).